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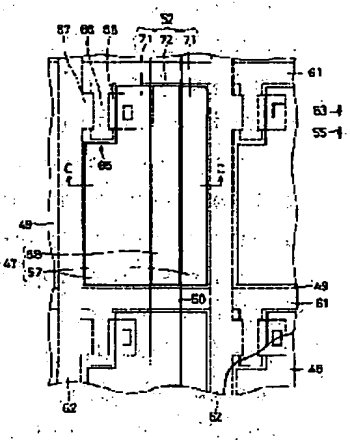
(54) LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To prevent the degradation of the display quality of a liquid crystal display device caused by alignment failure.
SOLUTION: In the liquid crystal display device, a liquid crystal layer is held between a first substrate and a second substrate, and a first alignment film 45 is formed between the first substrate and the liquid crystal layer. A plurality of pixel electrodes 47 and a controlling layer 49 having opening 50 are formed between the first substrate and the first alignment film 45. When the substrate is observed from its normal direction, the opening 50 is formed over the two pixel electrodes 47 adjacent to each other and almost parallel to the rubbing direction. Thereby, the wall face of the first alignment film 45 faces the direction except for the direction 55 opposite to the rubbing direction 53, and the first alignment film 45 is continuous in the part where the surface of the film has equal height from the surface of the first substrate in the region where the adjacent two pixel electrodes 47 almost parallel to the rubbing direction are arranged. Thereby, degradation in the display quality of the liquid crystal display device caused by the level difference of the first alignment film 45 can be prevented.



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CLAIMS

[Claim(s)]
[Claim 1] The liquid crystal layer arranged between the 1st substrate and the 2nd substrate which vacate spacing and counter mutually, and the 1st substrate and the 2nd substrate, Two or more pixel electrodes arranged between the 1st orientation film arranged between the 1st substrate and a liquid crystal layer, and the 1st substrate and the 1st orientation film, The interlayer film which is arranged between the 2nd substrate and a liquid crystal layer, and is arranged between each pixel electrode, the counterelectrode which counters, and the 1st substrate and the 1st orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand. A part of opening of an interlayer film The wall surface which is a front face of the part which lapped with the pixel electrode and the level difference of said 1st orientation film has produced is a liquid crystal display component characterized by having countered to the direction of [other than the opposite direction of the direction of rubbing].
[Claim 2] The wall surface of said 1st orientation film is a liquid crystal display component according to claim 1 characterized by having countered to the opposite direction of said direction of rubbing, and the direction of [other than the direction of rubbing].
[Claim 3] The liquid crystal layer arranged between the 1st substrate and the 2nd substrate which vacate spacing and counter mutually, and the 1st substrate and the 2nd substrate, Two or more pixel electrodes arranged between the 1st orientation film arranged between the 1st substrate and a liquid crystal layer, and the 1st substrate and the 1st orientation film, The interlayer film which is arranged between the 2nd substrate and a liquid crystal layer, and is arranged between each pixel electrode, the counterelectrode which counters, and the 1st substrate and the 1st orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand. A part of opening of an interlayer film The part with the equal height from the 1st substrate front face of the 1st orientation film front face in the field where it lapped with the pixel electrode and the pixel electrode of two ****** has been arranged together with abbreviation parallel in the direction of rubbing is a liquid crystal display component to which it is characterized by continuing.
[Claim 4] The liquid crystal layer arranged between the 1st substrate and the 2nd substrate which vacate spacing and counter mutually, and the 1st substrate and the 2nd substrate, Two or more pixel electrodes arranged between the 1st orientation film arranged between the 1st substrate and a liquid crystal layer, and the 1st substrate and the 1st orientation film, The interlayer film which is arranged between the 2nd substrate and a liquid crystal layer, and is arranged between each pixel electrode, the counterelectrode which counters, and the 1st substrate and the 1st orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is the liquid crystal

display component which is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand, and is characterized by opening of said interlayer film having lapped in the direction of rubbing ranging over the pixel electrode of two ****** together with abbreviation parallel.

[Claim 5] opening of said interlayer film is in said direction of rubbing together with abbreviation parallel at the direction side of rubbing of the pixel electrodes of two ****** — on the other hand — from the edge by the side of the direction of rubbing of a pixel electrode — this — the liquid crystal display component according to claim 4 characterized by having reached the edge by the side of this opposite direction of the another side pixel electrode in this opposite direction side of the two pixel electrodes.

[Claim 6] The edge by the side of the direction which intersects perpendicularly in the direction of rubbing of opening of said interlayer film is a liquid crystal display component according to claim 4 characterized by being the direction of rubbing, and abbreviation parallel.

[Claim 7] The level difference of the wall surface which has countered to said direction of rubbing among the wall surfaces which are front faces of the part which the level difference of said 1st orientation film has produced is a liquid crystal display component according to claim 4 characterized by being less than ten percent of the maximum thickness of the part which counters said pixel electrode of said liquid crystal layer.

[Claim 8] Said pixel electrode consists of the transparency section which penetrates light, and the reflective section which reflects the light which comes from said liquid crystal layer side. Said interlayer film It is arranged between the reflective section of said pixel electrode, and said 1st substrate. Opening of said interlayer film The light which passed the 1st optical path which laps with the transparency section of said pixel electrode, and carries out sequential passage of said 1st substrate, said pixel electrode transparency section, said liquid crystal layer, said counterelectrode, and said 2nd substrate, And at least one side of the light which passed the 2nd optical path which passes said 2nd substrate, said counterelectrode, and said liquid crystal layer, is reflected in said pixel electrode reflective section, and re-passes said liquid crystal layer, said counterelectrode, and said 2nd substrate The liquid crystal display component according to claim 1 to 7 characterized by setting up the thickness of said interlayer film so that it may be used for a display and the phase contrast of the light before and behind passage of the 1st optical path and the phase contrast of the light before and behind passage of the 2nd optical path may be in agreement.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the liquid crystal display component which performs

rubbing processing at the time of formation of the orientation film.
[0002]
[Description of the Prior Art] The liquid crystal display is widely used for the camera one apparatus video tape recorder (VTR) with which it is a thin shape and power consumption was equipped with portable information devices, such as OA equipment, such as a word processor and a personal computer, and an electronic notebook, and a monitor taking advantage of the description of being low. The liquid crystal display is equipped with the liquid crystal display component from which two or more pixels have been arranged in the shape of a matrix and which they consisted of at least. Unlike the spontaneous light type display represented by a cathode-ray tube and EL display, a liquid crystal display displays using the light from the liquid crystal display component outside. In the liquid crystal display of a transparency mold, the tooth-back light source realized with fluorescence tubing etc. is arranged at the tooth back of a liquid crystal display component, and the light which it is emitted from the tooth-back light source, and carries out incidence to a liquid crystal display component is used for a display. In the liquid crystal display of a reflective mold, the reflecting plate is arranged at the tooth back of a liquid crystal display component, and the outdoor daylight which carries out incidence to a liquid crystal display component from the front face of a liquid crystal display component is used for a display.
[0003] A transparency mold liquid crystal display can perform the bright display with high contrast, without being influenced by the brightness of the perimeter of equipment since it displays using the tooth-back light source. Since the power consumption of the tooth-back light source occupies 50% or more of the total power consumption of a transparency mold liquid crystal display, the power consumption of the whole transparency mold liquid crystal display tends to become large. Moreover, when a transparency mold liquid crystal display is set under an extremely bright environment, visibility tends to fall under fine weather. Since the tooth-back light source is not used for a reflective mold liquid crystal display, it can lessen power consumption of the whole equipment sharply. As for a reflective mold liquid crystal display, the brightness and contrast of a display are influenced according to operating environments, such as brightness of the perimeter of equipment.
[0004] The applicant for this patent has proposed the mold liquid crystal display both for transparency reflective having the function of both a transparency mold and a reflective mold (it is henceforth called for short "the mold LCD in two ways") in JP,11-109417,A, in order to solve the trouble of a transparency mold and a reflective mold liquid crystal display. For the mold LCD in two ways, the transparency field which can penetrate the light from the tooth-back light source in the field for 1 pixel of a liquid crystal display component, and the reflective field in which outdoor daylight can be reflected are **** rare ******. When dark in the perimeter of equipment, the mold LCD in two ways is used as a transparency mold liquid crystal display which displays using the light which was emitted from the tooth-back light source and passed through the transparency field. When bright in the perimeter of equipment, the mold LCD in two ways is used as a reflective mold liquid crystal display which displays by reflecting outdoor daylight in the high reflective field of the rate of a light reflex.
[0005] In the liquid crystal display component of the mold both for transparency reflective (it is henceforth called "the mold in two ways" for short) with which the mold LCD in two ways is equipped, a liquid crystal layer intervenes between the main substrate section containing an insulating substrate, and the opposite substrate section containing the substrate which has translucency. Drawing 7 is the partial expansion top view of the field for 2 pixels of the main substrate section of the liquid crystal display component in the mold LCD in two ways. Drawing 8 is the A-A end view of the main substrate section of drawing 7 . The liquid crystal display component of drawing 7 has composition of the active-matrix mold which used 3 terminal component as a switching element.
[0006] In the main substrate section 1, the transparency field 4 and the reflective field 5 are set to the field 3 for 1 pixel of the liquid crystal layer side front face of the 1st insulating substrate 2. It is formed in the transparency field 3 from ITO (indium-stannic acid ghost), and the pixel electrode transparency section 6 which can penetrate light is arranged. It is formed in the reflective field 4 from aluminum, and

the pixel electrode reflective section 7 which can reflect light is arranged. The pixel electrode transparency section 6 and the pixel electrode reflective section 7 constitute the pixel electrode 8 for 1 pixel. Between the pixel electrode reflective section 7 and the 1st substrate 2, the adjustment layer 9 which consists of the resin of an insulating material intervenes. The wiring 10 in connection with control of the pixel electrode 8 is arranged in the perimeter of the pixel field 3 of the 1st substrate front face. The adjustment layer 9 has extended not only to the reflective field 5 but to the field around the pixel field 3, and has covered wiring 10. The orientation film 11 is formed in the location which touches the liquid crystal layer of the main substrate section 1 recently. In addition, some orientation film 11 is omitted in drawing 7 .

[0007] If the mold LCD in two ways has composition which has arranged the polarizing plate to the front-face side of a liquid crystal display component at least, it is necessary to plan adjustment of the optical path length of the efficiency of light who uses for a display in case the mold LCD in two ways operates as a transparency mold liquid crystal display, and the optical path length of the efficiency of light who uses for a display in case the mold LCD in two ways operates as a reflective mold liquid crystal display. The adjustment layer 9 is a member for optical-path-length adjustment. By adjusting the thickness of the adjustment layer 9, the difference of the thickness of the liquid crystal layer of the transparency field 4 and the thickness of the liquid crystal layer of the reflective field 5 is adjusted, and two kinds of above-mentioned optical path lengths are adjusted. The thickness of the adjustment layer 9 has one half extent of the thickness of the part which faces the transparency field of a liquid crystal layer, and when the thickness of the part which faces the transparency field of a liquid crystal layer is 5.0 micrometers, the thickness of the adjustment layer 9 is 2.5 micrometers.

[0008] The liquid crystal display component of the mold in two ways is equipped with the addition part by volume for every pixel depending on the case. Drawing 9 is the partial expansion top view of the field for 2 pixels of the main substrate section 13 of the liquid crystal display component of the mold in two ways equipped with the addition part by volume. Drawing 10 is the B-B end view of the main substrate section 13 of drawing 7 R> 7. The configuration of those other than main substrate section 13 of the liquid crystal display component of drawing 9 is equal to the configuration of the liquid crystal display component of drawing 7 . The same reference mark is given to the components which have the function same among the components of the main substrate section 13 of drawing 9 as the components of the main substrate section 1 of drawing 7 , and explanation is omitted. In addition, the publication of some orientation film 11 is omitted with the top view of drawing 9 .

[0009] The liquid crystal display component of drawing 9 has composition of the active-matrix mold which used 3 terminal component as a switching element. In the main substrate section 13 of drawing 9 , the common wiring 14 for addition capacity is arranged on the liquid crystal layer side front face of the 1st substrate 2 so that it may become parallel to a passage and the wiring 10 for control about the location [directly under] of the pixel electrode reflective section 7. The part which the common wiring 14 and the pixel electrode reflective section 7 superimpose through the adjustment layer 9 functions as an addition part by volume 15 of a pixel. The pixel electrode transparency section 6 has extended to the reflective field 4, and has lapped with the pixel electrode reflective section 7 through the adjustment layer 9. The pixel electrode reflective section 7 is electrically connected with the pixel electrode transparency section 6 through the contact hole 16 established in the adjustment layer 9.

[0010]

[Problem(s) to be Solved by the Invention] In the main substrate sections 1 and 13 of the liquid crystal display component of the mold LCD in two ways explained by drawing 7 - drawing 10 , it originates in the adjustment layer 9 of liquid crystal thickness, and a level difference arises on orientation film 11 front face near the boundary of the transparency field 4 and the reflective field 5. The level difference of the orientation film 11 resulting from the adjustment layer 9 was crossed to the whole substrate front face, and is produced in every place.

[0011] The orientation film 11 of the main substrate sections 1 and 13 is formed by performing

orientation processing to the thin film which applies the ingredient of the orientation film on the 1st substrate 2 after pixel electrode 8 formation, and consists of an applied ingredient. Specifically for orientation processing, a rubbing roller carries out rubbing of the thin film front face which consists of a spreading ingredient in the predetermined direction 18 of rubbing, applying a predetermined pressure. Since irregularity is shown in a thin film front face when the adjustment layer 9 is formed in the main substrate sections 1 and 13, compared with heights, the effectiveness of orientation processing becomes weak, and, as for the crevice on the front face of a thin film, orientation processing of the whole orientation film front face is not carried out at homogeneity.

[0012] In the main substrate section of drawing 7 , the wall surface which is a part with the level difference resulting from the adjustment layer 9 in orientation film 11 front face is a taper configuration. Although the pre tilt angle of the about 21 wall surface [which counters in the direction 18 of rubbing among the wall surfaces of the orientation film 11] liquid crystal molecule 22 differs from the pre tilt angle of the about 23 flat part [in which only the part influenced of the taper configuration does not have the level difference of orientation film 11 front face] liquid crystal molecule 24, the direction as for which both liquid crystal molecules 22 and 24 carry out a tilt is equal to mutual. The wall surface 21 which counters in the direction 18 of rubbing hardly affects a display. In order that the liquid crystal molecule 26 near the wall surface 25 which counters the opposite direction of the direction of rubbing of orientation film 11 front face may start along with this wall surface 25, the direction as for which the this about 25 wall surface liquid crystal molecule 26 carries out a tilt differs from the direction as for which the about 23 flat part [without the level difference of orientation film 11 front face] liquid crystal molecule 24 carries out a tilt. The about 25 wall surface [which counters the direction 18 of rubbing and an opposite direction] liquid crystal molecule 26 is in the condition that the predetermined direction of a tilt inclines to hard flow, and the condition of the so-called reverse tilt. Consequently, the disclination line 27 is generated between a field with the wall surface 25 which counters the direction 18 of rubbing, and an opposite direction, and the field as for which the liquid crystal molecule is carrying out orientation normally, and the reverse tilt domain 28 is generated to a field with the wall surface 25 which counters the direction 18 of rubbing, and an opposite direction. The display grace of the mold LCD in two ways which has the main substrate section 1 of drawing 7 by this falls.

[0013] In the main substrate section 13 of drawing 9 , the part which laps with the common wiring 14, and the part which laps with wiring 10 have convex in the orientation film front face in the field for 1 pixel. The 29 or about 30 wall surface [which counters the direction of rubbing and opposite direction for these heights] liquid crystal molecule is in the condition of a reverse tilt. Consequently, since the disclination line 27 is generated between a field with the wall surfaces 29 and 30 which counter the opposite direction of the direction 18 of rubbing, and the field as for which the liquid crystal molecule is carrying out orientation normally and the reverse tilt domain 28 is generated to a field with the wall surfaces 29 and 30 which counter the direction 18 of rubbing, and an opposite direction, the display grace of the mold LCD in two ways which has the main substrate section 13 of drawing 9 falls.

[0014] The purpose of this invention is offering the liquid crystal display component with which generating of the poor display resulting from poor orientation is prevented in the liquid crystal display component which has the orientation film formed using rubbing processing by reducing the orientation membranous wall side which counters the opposite direction of the direction 18 of rubbing as much as possible.

[0015]

[Means for Solving the Problem] The 1st substrate and the 2nd substrate which this invention vacates spacing and counter mutually, The 1st orientation film arranged between the liquid crystal layer arranged between the 1st substrate and the 2nd substrate, and the 1st substrate and a liquid crystal layer, Two or more pixel electrodes arranged between the 1st substrate and the 1st orientation film, and the counterelectrode which is arranged between the 2nd substrate and a liquid crystal layer, and counters with each pixel electrode, The interlayer film which is arranged between the 1st substrate and the 1st

orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand. A part of opening of an interlayer film The wall surface which is a front face of the part which lapped with the pixel electrode and the level difference of said 1st orientation film has produced is a liquid crystal display component characterized by having countered to the direction of [other than the opposite direction of the direction of rubbing].

[0016] If this invention is followed, in a liquid crystal display component, the wall surface which counters the 1st orientation film by the side of the 1st substrate in the direction of rubbing and an opposite direction does not exist. The reverse tilt domain and disclination resulting from the wall surface which counters the direction of rubbing and an opposite direction in a liquid crystal display by this do not occur. Therefore, deterioration of the display grace resulting from the disclination in a liquid crystal display component is prevented.

[0017] Moreover, the liquid crystal display component of this invention is characterized by the wall surface of said 1st orientation film having countered to the opposite direction of said direction of rubbing, and the direction of [other than the direction of rubbing].

[0018] If this invention is followed, in a liquid crystal display component, both wall surfaces which originate in an interlayer film and counter the 1st orientation film by the side of the 1st substrate in the opposite direction of the direction of rubbing and the direction of rubbing exist. The interlayer film should just be formed in the band-like configuration as [the direction of rubbing and whose a longitudinal direction are abbreviation parallel] in order to form the 1st orientation film in this way. The edge of the interlayer film leading to the wall surface which counters said opposite direction by this can be lost easily and completely.

[0019] The 1st substrate and the 2nd substrate which this invention vacates spacing and counter mutually, The 1st orientation film arranged between the liquid crystal layer arranged between the 1st substrate and the 2nd substrate, and the 1st substrate and a liquid crystal layer, Two or more pixel electrodes arranged between the 1st substrate and the 1st orientation film, and the counterelectrode which is arranged between the 2nd substrate and a liquid crystal layer, and counters with each pixel electrode, The interlayer film which is arranged between the 1st substrate and the 1st orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand. A part of opening of an interlayer film The part with the equal height from the 1st substrate front face of the 1st orientation film front face in the field where it lapped with the pixel electrode and the pixel electrode of two ****** has been arranged together with abbreviation parallel in the direction of rubbing is a liquid crystal display component characterized by continuing.

[0020] If this invention is followed, in the liquid crystal display component, opening of an interlayer film is prepared so that a part with equal height may continue from a part with the equal level difference in the field where it stood in a line in parallel with the direction of rubbing, and each pixel electrode of two ****** has been arranged, i.e., the substrate front face in said 1st orientation film. By this, it is between the pixel electrodes of two ******, and becomes small enough at the direction of rubbing, an opposite direction, and extent to which the disclination to which the magnitude of the 1st orientation membranous wall side which counters originates in this wall surface does not affect display grace. Thus, since the liquid crystal display is constituted so that the wall surface which counters the opposite direction of the direction of rubbing may be reduced as much as possible, a liquid crystal display component can prevent deterioration of the display grace resulting from disclination certainly.

[0021] The 1st substrate and the 2nd substrate which this invention vacates spacing and counter mutually, The 1st orientation film arranged between the liquid crystal layer arranged between the 1st

substrate and the 2nd substrate, and the 1st substrate and a liquid crystal layer, Two or more pixel electrodes arranged between the 1st substrate and the 1st orientation film, and the counterelectrode which is arranged between the 2nd substrate and a liquid crystal layer, and counters with each pixel electrode, The interlayer film which is arranged between the 1st substrate and the 1st orientation film, and has opening is included. The 1st orientation film The process which forms a thin film in piles to the pixel electrode and interlayer film which have been arranged on the front face of the 1st substrate, It is manufactured according to the process which carries out rubbing of the thin film in the direction of rubbing which is one direction defined beforehand, and opening of said interlayer film is a liquid crystal display component characterized by having lapped in the direction of rubbing ranging over the pixel electrode of two ****** together with abbreviation parallel.

[0022] If this invention is followed, in the liquid crystal display component, opening of an interlayer film is formed so that the pixel electrode of two ****** may be straddled together with abbreviation parallel in the direction of rubbing. Of this, the field where an interlayer film does not exist between the pixel electrodes of two ****** is formed in the direction of rubbing together with abbreviation parallel. The field of the pixel electrodes of said two ****** which does not lap with the interlayer film of a pixel electrode on the other hand follows the field which does not lap with the interlayer film of the another side pixel electrode of the pixel electrodes of said two ****** through a field without a pixel inter-electrode interlayer film. Thus, when continuing without the field which does not lap with the interlayer film of a pixel electrode becoming independent for every pixel, the 1st orientation membranous wall side which originates at the edge of an interlayer film in a continuous field does not exist. It decreases rather than the number or magnitude of the 1st orientation membranous wall side where the number or magnitude of the 1st orientation membranous wall side which originates in the edge of the interlayer film in the liquid crystal display of this invention, and counters the opposite direction of the direction of rubbing by this originates in the edge of the interlayer film in the liquid crystal display component of the conventional technique, and counters the opposite direction of the direction of rubbing. Thus, since the liquid crystal display is constituted so that the wall surface which counters the opposite direction of the direction of rubbing may be reduced as much as possible, deterioration of the display grace resulting from the disclination in a liquid crystal display component is prevented certainly.

[0023] moreover, the liquid crystal display component of this invention has opening of said interlayer film in said direction of rubbing together with abbreviation parallel at the direction side of rubbing of the pixel electrodes of two ****** — on the other hand — from the edge by the side of the direction of rubbing of a pixel electrode — this — it is characterized by having reached the edge by the side of this opposite direction of the another side pixel electrode in this opposite direction side of the two pixel electrodes.

[0024] if this invention is followed, in a liquid crystal display component, opening of an interlayer film is in said direction of rubbing together with abbreviation parallel at the direction side of rubbing of the pixel electrodes of two ****** — on the other hand — from the edge by the side of the direction of rubbing of a pixel electrode — this — the edge by the side of this opposite direction of the another side pixel electrode in this opposite direction side of the two pixel electrodes is reached. By this, said 1st orientation membranous wall side which originates in the edge of an interlayer film and counters on the other hand in said opposite direction in the field from the edge by the side of the direction of rubbing of a pixel electrode to the edge by the side of this opposite direction of an another side pixel electrode does not exist. In the liquid crystal display which has such an interlayer film, the reverse tilt domain and disclination resulting from the wall surface which counters the direction of rubbing and an opposite direction do not occur. Therefore, a liquid crystal display component can prevent deterioration of the display grace resulting from disclination.

[0025] Moreover, the edge by the side of the direction where the liquid crystal display component of this invention intersects perpendicularly in the direction of rubbing of opening of said interlayer film is characterized by being the direction of rubbing, and abbreviation parallel.

[0026] If this invention is followed, in the liquid crystal display component, the edges by the side of the

direction which intersects perpendicularly in the direction of rubbing of opening of an interlayer film are abbreviation parallel in the direction of rubbing. By this, it stands in a line in parallel with the direction of rubbing, and the orientation membranous wall side which counters with the opposite direction of the direction of rubbing between the pixel electrodes of two ****** does not exist. Therefore, a liquid crystal display component can prevent deterioration of the display grace resulting from disclination still more certainly.

[0027] Moreover, the level difference of the wall surface which has countered to said direction of rubbing among the wall surfaces which are front faces of a part where the level difference of said 1st orientation film has produced the liquid crystal display component of this invention is characterized by being less than ten percent of the maximum thickness of the part which counters said pixel electrode of said liquid crystal layer.

[0028] If this invention is followed, in the liquid crystal display component, the level difference of the wall surface which has countered to the opposite direction of the direction of rubbing of the orientation film by the side of the 1st substrate is larger than 0, and has become the value of less than ten percent of the maximum thickness of the part which counters the pixel electrode of a liquid crystal layer. The wall surface which has the level difference of less than ten percent of said maximum thickness does not affect rubbing processing. Therefore, if the level difference of the 1st orientation membranous wall side which counters the opposite direction of the direction of rubbing left behind to the 1st orientation film is stopped by said less than ten percent of maximum thickness, the 1st orientation membranous wall side which laps with the end face on the pixel electrode of an interlayer film countering in the direction of [other than the direction of / other than the opposite direction of the direction of rubbing / or the direction of rubbing, and said opposite direction], generating of a reverse tilt domain and disclination can be prevented. A liquid crystal display component can prevent deterioration of the display grace resulting from disclination certainly by this.

[0029] The liquid crystal display component of this invention moreover, said pixel electrode It consists of the transparency section which penetrates light, and the reflective section which reflects the light which comes from said liquid crystal layer side. Said interlayer film It is arranged between the reflective section of said pixel electrode, and said 1st substrate. Opening of said interlayer film The light which passed the 1st optical path which laps with the transparency section of said pixel electrode, and carries out sequential passage of said 1st substrate, said pixel electrode transparency section, said liquid crystal layer, said counterelectrode, and said 2nd substrate, And at least one side of the light which passed the 2nd optical path which passes said 2nd substrate, said counterelectrode, and said liquid crystal layer, is reflected in said pixel electrode reflective section, and re-passes said liquid crystal layer, said counterelectrode, and said 2nd substrate It is characterized by setting up the thickness of said interlayer film so that it may be used for a display and the phase contrast of the light before and behind passage of the 1st optical path and the phase contrast of the light before and behind passage of the 2nd optical path may be in agreement.

[0030] If this invention is followed, the liquid crystal display component has composition of the mold both for transparency reflective. The interlayer film of a liquid crystal display component is used for adjustment of the phase contrast of the light before and behind passage of the 1st optical path, and the phase contrast of the light before and behind passage of the 2nd optical path. or [that the wall surface which counters the opposite direction of the direction of rubbing of the 1st orientation film front face by the side of the 1st substrate does not exist in such a liquid crystal display component] -- or since it is decreasing as much as possible, generating of the reverse tilt domain and disclination resulting from this wall surface is fully suppressed. Therefore, the liquid crystal display component of the mold in two ways can prevent deterioration of the display grace resulting from disclination.

[0031]

[Embodiment of the Invention] Drawing 1 is the partial expansion top view of main substrate section 33A which the liquid crystal display component 33 of the mold in two ways which is the gestalt of operation

of the 1st of this invention has. Drawing 2 is the partial expanded sectional view of the mold liquid crystal display 31 both for transparency reflective equipped with the liquid crystal display component 33 of drawing 1 (it is henceforth called for short "the mold LCD in two ways"). Drawing 1 and drawing 2 are doubled and explained. The cross section of the mold LCD 31 in two ways of drawing 2 includes the C–C cross section of main substrate section 33A of drawing 1 . In addition, in the top view of drawing 1 , the publication of some 1st orientation film 45 mentioned later is omitted.

[0032] The mold LCD 31 in two ways includes the 1st polarizing plate 35, the 2nd polarizing plate 36, the 1st optical compensating plate 37, the 2nd optical compensating plate 38, and the light source 39 other than the liquid crystal display component 33 of the mold in two ways. Each optical compensating plates 37 and 38 are realized by the quarter–wave length plate. Roughly, the liquid crystal display component 33 contains the 1st substrate 41, the 2nd substrate 42, the liquid crystal layer 43, the 1st orientation film 45, the 2nd orientation film 46, two or more pixel electrodes 47, the pixel electrode 47 and the counterelectrode 48 of the same number, and the adjustment layer 49 of liquid crystal thickness.

[0033] The 1st substrate 41 and the 2nd substrate 42 have translucency, they vacate spacing and opposite arrangement is carried out. As for the 1st substrate 41, inside [it is two substrates 41 and 42] has insulation at least. The liquid crystal layer 43 is arranged between two substrates 41 and 42. The 1st orientation film 45 is arranged between the 1st substrate 41 and the liquid crystal layer 43. The 2nd orientation film 46 is arranged between the 2nd substrate 42 and the liquid crystal layer 43. The orientation film 45 and 46 of two sheets touches the liquid crystal layer 43 recently. All the pixel electrodes 47 are arranged between the 1st substrate 41 and the 1st orientation film 45. Each counterelectrode 48 is arranged between the 2nd substrate 42 and the 2nd orientation film 46, and counters with each pixel electrode 47. The adjustment layer 49 is an interlayer film which intervenes between the 1st substrate 41 and the 1st orientation film 47, and has at least one opening 50. The single opening 50 of the adjustment layer 49 is arranged so that it may lap with the pixel electrode of two ****** together with abbreviation parallel in the direction 53 of rubbing mentioned later.

[0034] The part pinched with the pixel electrode 47 and the counterelectrode 48 constitutes the pixel. The field by the side of the liquid crystal layer 23 of the 1st substrate 41 where each pixel electrode 47 in a front face 51 has been arranged on the other hand is called the pixel field 52. The part which consists of the member between the 1st substrate 41 in the liquid crystal display component 33 and the 1st substrate 41, and the liquid crystal layer 43 is named "main substrate section 33A" generically. The 1st orientation film 45 touches the liquid crystal layer 63 rather than any member in main substrate section 33A recently. The part which consists of the member between the 2nd substrate 42 in the liquid crystal display component 33 and the 2nd substrate 42, and the liquid crystal layer 43 is named "opposite substrate section 33B" generically.

[0035] The 1st orientation film 45 is manufactured according to the process which carries out rubbing of the thin film in the direction 53 of rubbing which is one direction beforehand determined to the pixel electrode 47 and the adjustment layer 49 of the 1st substrate 41 which have already been arranged on the front face 51 on the other hand as the process which forms a thin film in piles. Like the 1st orientation film 45, the 2nd orientation film 45 may be manufactured according to the membrane formation process and rubbing process of a thin film, and may be manufactured using the other manufacture technique, for example, vacuum deposition.

[0036] As for the front face (a "wall surface" is called henceforth) of a part with the level difference of the 1st orientation film 45, it is desirable to have countered to the direction of [other than direction ("direction of reverse rubbing" is called henceforth) 55 / opposite to the direction 53 of rubbing]. When the wall surface which counters in the direction 55 of reverse rubbing remains in the 1st orientation film 45, the level difference of the wall surface which remains is larger than 0, and it is desirable that it is the value of less than ten percent of the maximum thickness dt of the part which counters the pixel electrode 47 of the liquid crystal layer 43. With the gestalt of this operation, the wrap orientation membranous wall side 54 has countered the end face of the adjustment layer 49 which is in the pixel

field 52 among the wall surfaces of the 1st orientation film 45 to the direction 55 of reverse rubbing, and the directions of the remainder other than direction of rubbing 53. all between the 1st orientation film 45 and the 1st substrate 41 — the level difference of a wrap orientation membranous wall side has become said less than ten percent of maximum thickness dt about the end face of residual members other than adjustment layer 49 of the material.

[0037] With the gestalt of this operation, since the liquid crystal display component 33 is a mold in two ways, the pixel electrode 47 consists of the reflective section 47 which consists of a conductive ingredient which can reflect light, and the transparency section 48 which consists of a conductive ingredient which can penetrate light. The pixel electrode reflective section 57 is arranged to the reflective field 71 in which the light in the pixel field 52 should be reflected. The pixel electrode transparency section 58 is arranged to the transparency field 72 which should make the light in the pixel field 52 penetrate.

[0038] In the mold liquid crystal display component 33 in two ways, the adjustment layer 49 is used in order to adjust the thickness dr of the part which counters the pixel electrode reflective section 57 of the liquid crystal layer 43, i.e., the thickness of the liquid crystal layer reflective section. The adjustment layer 49 intervenes between the reflective section 47 and the 1st substrate 41. The opening 50 of the adjustment layer 49 was seen from [of 1st substrate 41 front face] the normal, and has lapped with the transparency section 58. In the liquid crystal display component 33 of the mold in two ways, the maximum thickness dt of the part which counters the pixel electrode 47 of the liquid crystal layer 43 is the thickness of the part which counters the pixel electrode transparency section 58 of the liquid crystal layer 43, i.e., the thickness of the liquid crystal layer transparency section.

[0039] Two polarizing plates 35 and 36 have countered on both sides of the liquid crystal display component 33. The 1st optical compensating plate 37 intervenes between the 1st polarizing plate 35 and the 1st substrate 41. The 2nd optical compensating plate 38 intervenes between the 2nd polarizing plate 36 and the 2nd substrate 42. The 1st polarizing plate 35 intervenes between the 1st optical compensating plate 37 and the light source 39. The 2nd polarizing plate 36 side of the mold LCD 31 in two ways is a front-face side of the mold LCD 31 in two ways, and the light source 39 side of the mold LCD in two ways is a tooth-back side of the mold LCD 31 in two ways. A user attends the mold LCD 31 in two ways from the front-face side of the mold LCD 31 in two ways.

[0040] With the gestalt of this operation, in more detail, since the liquid crystal display component 33 is a liquid crystal display component of the active-matrix mold in which color display is possible, the liquid crystal display component 33 contains further the switching element 65 of the signal line 62 of two or more two or more [61 or] scanning lines, an interlayer insulation film 63, the pixel electrode 47, and the same number, two or more color filter layers 69, and the protection-from-light layer 70. The switching element 65 is realized by the gestalt of this operation by the thin film transistor (TFT) which is 3 terminal component. There are the two pixel electrode reflective sections 57 per pixel. The concrete configuration of the liquid crystal display component 33 is as follows.

[0041] The 1st substrate 41 has the composition that the base coat film of the substrate which has translucency and insulation which has insulation in a field on the other hand is formed. All the scanning lines 61 vacate spacing mutually in parallel with mutual, and are arranged on the one side front face 51 of the 1st substrate 41. All the signal lines 62 vacate spacing mutually in parallel with mutual, and are arranged on the one side front face 51 of the 1st substrate 41. From [on the front face 51 of one side of the 1st substrate 41] a normal, the longitudinal direction of the scanning line 61 and the longitudinal direction of a signal line 62 are seen, and lie at right angles. With the gestalt of this operation, the longitudinal direction of a signal line 62 is parallel to the direction 53 of rubbing. The interlayer insulation film 63 intervened between the scanning line 61 and a signal line 62, and has covered the one side surface 51 whole of the 1st substrate 41. The pixel electrode 47 and the adjustment layer 49 intervene between an interlayer insulation film 63 and the 1st orientation film 45.

[0042] The rectangle field surrounded with the scanning line 61 and a signal line 62 is equivalent to the

pixel field 52. Two or more pixel fields 52 are located in a line in the shape of a matrix. The train of the array of a pixel field or the direction of a line is the direction 52 of rubbing, and abbreviation parallel. In the single pixel field 52, the reflective field 71 is divided by the transparency field 72 two. The irregularity of the shape of a continuous wave is formed in the front face of the adjustment layer 49. In order to form irregularity in adjustment layer 49 front face, as for the adjustment layer 49, being formed with the photosensitive resin film is desirable.

[0043] The pixel electrode 47 is arranged to each one pixel field 52 of every. It sees from [of the 1st substrate 41] a normal, and the single pixel electrode transparency section 58 is arranged between the two pixel electrode reflective sections 57 in the single pixel field 52. The pixel electrode reflective section 57 is formed of aluminum that what is necessary is to just be formed from a conductive ingredient with a comparatively high reflection factor. The pixel electrode transparency section 58 is formed from ITO (tin-indium-oxide) that what is necessary is to just be formed from a conductive ingredient with comparatively high transmission. The reflective section 47 and the transparency section 58 may be formed from aluminum and another ingredients other than ITO.

[0044] The two pixel electrode reflective sections 57 and the pixel electrode transparency section 58 which constitute the single pixel electrode 47 are connected electrically. For connection, the edge of each pixel electrode reflective section 57 covers the end face of the adjustment layer 49, and is extended, and it is directly in contact with the pixel electrode transparency section 58. The pixel electrode reflective section 57 and the pixel electrode transparency section 58 are easily connectable with this. The configuration of not only the above-mentioned configuration but others [configuration / for connection] of the pixel electrode reflective section 57 and the pixel electrode transparency section 58 may be used. For example, a contact hole is formed in the location [directly under] of the pixel electrode reflective section 57 of right and left of the adjustment layer 49, respectively, the pixel electrode transparency section 58 is extended to the location [directly under] of this contact hole, and the pixel electrode reflective section 57 on either side may be connected to the pixel electrode transparency section 58 through this contact hole.

[0045] In each corner of each pixel field 52, one TFT65 which is a switching element is arranged. The gate electrode 66 of TFT65 is connected with the scanning line 61, and the source electrode 67 of TFT65 is connected with a signal line 62. The above-mentioned adjustment layer 49 intervenes between the drain electrode 68 of TFT65, and the pixel electrode reflective section 57. The drain electrode 68 is connected with the pixel electrode reflective section 57 on the left-hand side of a drawing through the contact hole established in the adjustment layer 49. The configuration of not only the above-mentioned configuration but others [configuration / for connection] of the pixel electrode 47 and TFT65 may be used. For example, instead of connecting the pixel electrode reflective section 57 and the drain electrode on the left-hand side of a drawing through the contact hole of the adjustment layer 49, some drain electrodes 68 of TFT65 may be extended, the extension section of the drain electrode 68 may be arranged between the adjustment layer [directly under] 49 of the pixel electrode reflective section 57 on the left-hand side of a drawing, and an interlayer insulation film 63, and the drain electrode 68 may be connected to the pixel electrode transparency section 58 through this extension section. The pixel electrode 47 and the drain electrode 68 are easily connectable with this.

[0046] The color filter layer 69 and the protection-from-light layer 70 intervene between the 2nd substrate 41 and the 2nd orientation film 46. The color filter layer 69 has countered with the pixel electrode 47, and the protection-from-light layer 70 has countered as a black matrix with the field where the field 61 between the pixel fields 52, for example, the scanning line, and the signal line 62 have been arranged. The counterelectrode 48 of all pixels is unified and the transparent electrode of one sheet consists of gestalten of this operation.

[0047] As for the liquid crystal layer 43, main substrate section 33A and opposite substrate section 33B oppose the orientation film 45 and 46 comrades, and it vacates and arranges spacing, between both the substrates sections, encloses a liquid crystal ingredient and is formed. With the gestalt of this operation,

the liquid crystal layer 23 is formed from the liquid crystal ingredient whose dielectric anisotropy is forward. The liquid crystal ingredient which has a forward dielectric anisotropy is realized by the gestalt of this operation by ZLI-4792 (trade name) by ZLI-3926 (trade name) or Merck Co. by Merck Co. Spacing of both the substrates sections 33A and 33B is adjusted so that the thickness dt of the transparency section of the liquid crystal layer 23 may be set to about 5.0 micrometers. The thickness of the adjustment layer 49 is set as about 2.5 micrometers with the abbreviation one half of the transparency member thickness dt, and the gestalt of this operation.

[0048] While the electrical potential difference has not arisen between the pixel electrode 47 and the counterelectrode 48, the orientation film 45 and 46 of two sheets regulates the orientation condition of a liquid crystal molecule so that the direction of a major axis of the liquid crystal molecule in the liquid crystal layer 43 may become the liquid crystal layer side front face of substrates 41 and 42, and abbreviation parallel and orientation may be carried out in parallel with the direction 53 of rubbing. When the 1st orientation film 45 is AL4552 (trade name) made from JSR and a liquid crystal ingredient is ZLI-3926 by Merck Co., the pre tilt angle of the liquid crystal molecule at the time of no electrical-potential-difference impressing is 2 times [3 or less] or more. Since the liquid crystal molecule has the pre tilt at the time of no electrical-potential-difference impressing, when an electrical potential difference is impressed between the pixel electrode 47 and a counterelectrode 48, a liquid crystal molecule starts uniformly and carries out reorientation in the direction in which the liquid crystal molecule has constituted the pre tilt in the direction almost perpendicular to 1st substrate 41 front face.

[0049] Each optical compensating plates 37 and 38 are quarter-wave length plates, and when the liquid crystal layer 43 is a forward parallel orientation liquid crystal layer which has a forward dielectric anisotropy, the 1st polarizing plate 35 and the 1st optical compensating plate 37 are arranged so that the include angle a direction parallel to the polarization shaft of the 1st polarizing plate 35 and whose direction parallel to the lagging axis of the 1st optical compensating plate 37 are 45 degrees may be accomplished. And the 2nd polarizing plate 36 and the 2nd optical compensating plate 38 are arranged so that the include angle a direction parallel to the polarization shaft of the 2nd polarizing plate 36 and whose direction parallel to the lagging axis of the 2nd optical compensating plate 38 are 45 degrees may be accomplished. The lagging axis of the 1st optical compensating plate 37 and the lagging axis of the 2nd optical compensating plate 38 are parallel to mutual. The mold LCD 31 in two ways turns into a normally white mold by this.

[0050] The production process of the main substrate section of the liquid crystal display component 33 of drawing 1 is as follows. First, in order to form the 1st substrate 41, the base coat film of the substrate which has translucency and insulation which has insulation in a field on the other hand is formed. The base coat film is formed from Ta 2O5 or SiO2. Subsequently, the thin film which consists of the ingredient which has protection-from-light nature and conductivity on the base coat film is formed using the sputtering method, and patterning of this thin film is carried out to a predetermined configuration. The scanning line 61 and the gate electrode 66 of TFT65 are formed of this. The ingredient of the scanning line 61 and the gate electrode 66 is realized by the metallic material (aluminum), for example, aluminum, molybdenum (Mo), or the tantalum (Ta).

[0051] Subsequently, the laminating of the interlayer insulation film 63 is carried out so that the scanning line 61 and the gate electrode 66 may be covered on the 1st substrate 41. The thin film of SiNx with which the laminating of the SiNx is carried out on the 1st substrate 41 after scanning-line manufacture until thickness becomes 3000A, and an interlayer insulation film 63 is formed as a result for example, using P-CVD method is used as an interlayer insulation film 63. The interlayer insulation film 63 may have two-layer structure, in order to raise insulation. When an interlayer insulation film 63 is two-layer structure, the front face of the scanning line 61 and the gate electrode 66 is anodized first, subsequently to the 1st substrate 41 top after anodizing, a CVD method is used and the laminating of the SiNx is carried out. The oxide film on anode and SiNx thin film which are obtained as a result constitute an interlayer insulation film 63.

[0052] The 1st thin film formed from the ingredient of the channel layer of TFT65 is formed on an interlayer insulation film 63 after interlayer insulation film 63 formation using a CVD method. The 2nd thin film subsequently formed from the ingredient of the electrode contact layer of TFT65 is continuously formed on the 1st thin film using a CVD method from membrane formation of the 1st thin film. The 1st thin film is realized by for example, the amorphous silicon film. The 2nd thin film is realized by the microcrystal silicon film by which impurities, such as amorphous silicon film with which impurities, such as Lynn, were doped, or Lynn, were doped. The thickness of the 1st thin film is 1500A, and the thickness of the 2nd thin film is 500A. Subsequently, patterning of the 1st thin film and the 2nd thin film is carried out to a predetermined configuration using the dry etching method for using the mixed gas of HCl and SF6. Of this, the channel layer of TFT65 and the electrode contact layer of TFT65 are formed.
[0053] Subsequently, the 3rd thin film which consists of the ingredient which has translucency and conductivity on the 1st substrate 41 is formed using the sputtering method so that the channel layer and electrode contact layer of TFT65 may be covered. The ingredient of the 3rd thin film is realized by ITO. Then, ** 4 thin film which consists of the ingredient which has protection-from-light nature and conductivity on the 3rd thin film carries out a laminating, and is formed. The ingredient of the 4th thin film is realized by the metallic material (aluminum), for example, aluminum, molybdenum (Mo), or the tantalum (Ta). Subsequently, patterning of the 3rd thin film and the 4th thin film is carried out to a predetermined configuration. Consequently, the source electrode 67 of TFT65, the drain electrode 68 of TFT65, a signal line 62, and the pixel electrode transparency section 58 are formed. the layer to which the source electrode 67, the drain electrode 68, and a signal line 62 change from a part of 3rd thin film, and the layer which consists of a part of 4th thin film — ** — it has two-layer structure. The pixel electrode transparency section 58 is formed from a part of 3rd thin film. Subsequently, it consists of an insulating ingredient, the 5th thin film whose thickness is 3000A is formed using a CVD method, patterning is carried out to a predetermined configuration, and a contact hole is further formed in a predetermined location so that TFT65 may be covered. The protective coat of TFT65 is formed by this. In addition, the protective coat is not illustrated by drawing 1 .
[0054] Subsequently, the photopolymer which has insulation is applied on the 1st substrate 41 so that TFT65, the scanning line 61, a signal line 62, and the pixel electrode transparency section 58 may be covered. The thickness of the thin film of a photopolymer is about 4 micrometers. Exposure processing, a development, and heat treatment are added to the thin film of a photopolymer after resin spreading. Consequently, two or more smooth irregularity is formed in the thin film front face of a photopolymer. The part on the contact hole of a protective coat, the part on the transparency field 72, and the part on the transparency border area 76 are removed from a photopolymer thin film after concavo-convex completion. The adjustment layer 49 is completed by this. the gestalt of this operation — as the ingredient of the adjustment layer 49 — Tokyo — adaptation — shrine 800 [OFPR-] (trade name) is used. if the ingredient of the adjustment layer 49 is a photosensitive resin ingredient — not only OFPR-800 but other ingredients, for example, Tokyo, — adaptation — shrine 83 [OMR-] and OMR- you may be 85, ONNR-20, OFPR-2, OFPR-830, or OFPR-500 (trade name). Or the ingredients of the adjustment layer 49 may be TF-20 made from Shipley, 1300-27, 1400-27 (trade name), etc., or may be RW-1 (trade name) of photograph NISU (trade name) by Toray Industries, Inc., and the Sekisui fine chemical company nature, and R001 and R633 by Nippon Kayaku Co., Ltd. (trade name).
[0055] After adjustment layer completion, using the sputtering method, the thin film which consists of the ingredient which has light reflex nature and conductivity is formed so that the adjustment layer 49 may be covered, and patterning of this thin film is carried out to a predetermined configuration. As a result, the pixel electrode reflective section 57 is completed. The ingredient of the reflective section 57 is realized by a metallic material (aluminum), for example, aluminum, or molybdenum (Mo). The reflective section 57 may have two-layer structure, in this case, the laminating of the piece of the film of the aluminum whose thickness is 1000A, and the piece of the film of the molybdenum whose thickness is 500A is carried out, and the reflective section 57 is formed. Irregularity is formed also in reflective

section 57 front face, when patterning of the thin film is formed and carried out and the reflective section 57 is formed on the adjustment layer 49 which has irregularity in a front face. Thus, the reflective section 57 which has irregularity in a front face can have a good reflection factor and a dispersion property.

[0056] After pixel electrode reflective section completion, the thin film which consists of the ingredient of the 1st orientation film 45 is formed on the 1st substrate 41 so that the adjustment layer 49, the pixel electrode reflective section 57, and the pixel electrode transparency section 58 may be covered. The ingredient of the 1st orientation film 45 is realized by OPUTOMA AL4552LL made from for example, JSR (trade name). Subsequently, a rubbing roller carries out rubbing of the front face of the formed thin film in the predetermined direction 53 of rubbing as rubbing processing, applying a predetermined pressure. Main substrate section 33A of the liquid crystal display component 33 is completed according to the above process which the orientation film 45 completes as a result. In addition, a concrete configuration, the concrete quality of the material, the manufacture approach, etc. of a component part of the liquid crystal display component 33 explained in the concrete configuration and the manufacture approach of the liquid crystal display component 33 are one of the optimal examples of the liquid crystal display component 33. If the configuration of the liquid crystal display component 33 is a configuration for decreasing the wall surface which counters in the direction 55 of reverse rubbing from 1st orientation film 45 front face as much as possible, it will not restrict a detail configuration to the above-mentioned explanation.

[0057] With reference to drawing 2 , the display mode of the mold LCD 31 in two ways is explained. In the reflective mode which is the case where the mold LCD 31 in two ways operates as a reflective mold LCD, the light which passes through the reflective field 71 of the pixel field 52 is used for a display. In the transparent mode which is the case where the mold LCD 31 in two ways operates as a transparency mold LCD, the light which passes through the transparency field 72 of the pixel field 52 is used for a display. It becomes settled from a pixel whether the light used for a display is injected according to whether predetermined electric field are impressed between the pixel electrode 47 of a pixel, and the counterelectrode 48.

[0058] In the single pixel of arbitration, the behavior of the light at the time of reflective mode is as follows. The light which carried out incidence into the liquid crystal display component 33 from the front face of the 2nd polarizing plate 36 turns into the linearly polarized light which vibrates in the direction parallel to the polarization shaft of the 2nd polarizing plate 36 by passing the 2nd polarizing plate 36. Since the polarization shaft of the 2nd polarizing plate 36 and the lagging axis of the 2nd optical compensating plate 38 have accomplished 45 degrees, the linearly polarized light after 2nd polarizing plate 36 passage turns into the circular polarization of light by carrying out incidence to the 2nd optical compensating plate 38, and passing. The circular polarization of light passes opposite substrate section 33B of the liquid crystal display component 33, and it carries out incidence to the liquid crystal layer 43 from the 2nd substrate 42 side.

[0059] When the electrical potential difference beforehand defined between the pixel electrode 47 of a single pixel and a counterelectrode 48 is impressed, predetermined electric field occur in the liquid crystal layer 43 between this pixel electrode and a counterelectrode. If the liquid crystal layer 43 is formed from the liquid crystal ingredient in which a forward dielectric anisotropy is shown, reorientation of the liquid crystal molecule of the liquid crystal layer 43 between the pixel electrode 47 of an arbitration pixel and a counterelectrode 48 is carried out in the direction almost perpendicular to the front face of substrates 41 and 42 from the condition which was carrying out orientation in the direction level on the front face of substrates 41 and 42. Therefore, the refractive-index anisotropies of the electrode 47 in an arbitration pixel and the liquid crystal layer 43 between 48 are very few, and the phase contrast which produces this liquid crystal layer 43 when light passes is about 0. Therefore, when the circular polarization of light after 2nd optical compensating plate 38 passage carries out incidence to the electrode 47 with which the predetermined electrical potential difference was impressed, and the

liquid crystal layer 43 which it is between 48, it goes on in the direction which faces to the 1st substrate 41 from the 2nd substrate 42, with the circular polarization of light not broken down, the liquid crystal layer 43 is passed, and it is reflected in the pixel electrode reflective section 57 on the 1st substrate 41.
[0060] The reflected circular polarization of light advances in the direction which faces to the 2nd substrate 42 from the 1st substrate 41, not breaking down reentry putting and the circular polarization of light into the liquid crystal layer 43 from the 1st substrate 41 side, passes the liquid crystal layer 43, passes opposite substrate section 33B, and it carries out incidence to the 2nd optical compensating plate 38 again. The circular polarization of light which carried out re-incidence turns into the linearly polarized light which vibrates in the direction which intersects perpendicularly with the polarization shaft of the 2nd polarizing plate 36 by passing the 2nd optical compensating plate 38. The linearly polarized light after 2nd polarizing plate 36 re-passage is absorbed by the 2nd polarizing plate 36, without passing the 2nd polarizing plate 36, since it is vibrating in the direction which intersects perpendicularly with a polarization shaft. Thus, a pixel becomes a black display when predetermined electric field have occurred between the pixel electrode 47 and a counterelectrode 48.
[0061] Since predetermined electric field do not occur in the liquid crystal layer 43 which it is between this pixel electrode 47 and a counterelectrode 48 when the predetermined electrical potential difference is not impressed between the pixel electrode 47 of a single pixel, and the counterelectrode 48, the liquid crystal molecule in this liquid crystal layer 43 maintains the condition of carrying out orientation in the direction level on the front face of substrates 41 and 42. Therefore, the refractive-index anisotropy of the liquid crystal layer 43 between the pixel electrode 47 and a counterelectrode 48 is fully large. Therefore, when the circular polarization of light after 2nd optical compensating plate 38 passage carries out incidence to the electrode 47 with which the predetermined electrical potential difference is not impressed, and the liquid crystal layer 43 which it is between 48, if these two electrodes 47 and the liquid crystal layer 43 between 48 are passed, the circular polarization of light will originate in the birefringence of this liquid crystal layer 43, and will turn into elliptically polarized light.
[0062] It is reflected in the pixel electrode reflective section 57 on the 1st substrate 41, and re-incidence of the elliptically polarized light after liquid crystal layer 43 passage is carried out to the liquid crystal layer 43 from the 1st substrate 41 side. By passing the liquid crystal layer 43, a polarization condition is broken down further and incidence of the elliptically polarized light which carried out re-incidence is again carried out to the 2nd optical compensating plate 38. Even if the elliptical light which carried out re-incidence passes the 2nd optical compensating plate 38, it does not turn into the linearly polarized light which vibrates in the direction which intersects perpendicularly with the polarization shaft of the 2nd polarizing plate 36. Therefore, the component which vibrates in the direction parallel to the polarization shaft of the 2nd polarizing plate 36 among all the polarization components of the light after 2nd optical compensating plate 38 passage passes the 2nd polarizing plate 36. Thus, a pixel becomes a white display when predetermined electric field have not occurred between the pixel electrode 47 and a counterelectrode 48.
[0063] In the single pixel of arbitration, the behavior of the light at the time of the transparent mode is as follows. The light which carried out incidence into the liquid crystal display component 33 from the front face of the 1st polarizing plate 35 turns into the linearly polarized light which vibrates in the direction parallel to the polarization shaft of the 1st polarizing plate 35 by passing the 1st polarizing plate 35. Since the polarization shaft of the 1st polarizing plate 35 and the lagging axis of the 1st optical compensating plate 37 have accomplished 45 degrees, the linearly polarized light after 1st polarizing plate 35 passage turns into the circular polarization of light by carrying out incidence to the 1st optical compensating plate 37, and passing. The circular polarization of light passes through the transparency field 72 of main substrate section 33A of the liquid crystal display component 33, and it carries out incidence to the liquid crystal layer 43 from the 1st substrate 41 side.
[0064] When predetermined electric field have occurred between the pixel electrode 47 of a single pixel, and a counterelectrode 48, the phase contrast produced when light passes the part pinched by these

two electrodes 47 and 48 of the liquid crystal layer 43 is about 0. If predetermined electric field have arisen in the liquid crystal layer 43 of an arbitration pixel, the circular polarization of light after liquid crystal layer 43 incidence will advance in the direction which faces to the 2nd substrate 42 from the 1st substrate 41, not breaking down the circular polarization of light, will pass the liquid crystal layer 43, and it will carry out incidence to the 2nd optical compensating plate 38. Since the lagging axis of the lagging axis of the 1st optical compensating plate 37 and the 2nd optical compensating plate 38 has gathered, the circular polarization of light after liquid crystal layer 43 passage turns into the linearly polarized light to which the polarization shaft of the 2nd polarizing plate 36 vibrates in the direction which intersects perpendicularly by passing the 2nd optical compensating plate 38. The linearly polarized light after 2nd polarizing plate 36 re-passage is absorbed by the 2nd polarizing plate 36. Thus, a pixel becomes a black display when predetermined electric field have occurred between the pixel electrode 47 and a counterelectrode 48.

[0065] When predetermined electric field have not occurred between the pixel electrode 47 of a single pixel, and a counterelectrode 48, if these two electrodes 47 and the liquid crystal layer 43 between 48 are passed, the circular polarization of light after 1st optical compensating plate 37 passage will originate in the birefringence of this liquid crystal layer 43, and will turn into elliptically polarized light. Incidence of the elliptically polarized light is carried out to the 2nd optical compensating plate 38. Even if the elliptically polarized light after liquid crystal layer 43 passage passes the 2nd optical compensating plate 38, it does not turn into the linearly polarized light which vibrates in the direction which intersects perpendicularly with the polarization shaft of the 2nd polarizing plate 36. Therefore, the component which vibrates in the direction parallel to the polarization shaft of the 2nd polarizing plate 36 among all the polarization components of the light after 2nd optical compensating plate 38 passage passes the 2nd polarizing plate 36. Thus, a pixel becomes a white display when predetermined electric field have not occurred between the pixel electrode 47 and a counterelectrode 48.

[0066] As explained above, in the mold LCD 31 in two ways, either reflective mode or the transparent mode can adjust the quantity of light of the light which passes the 2nd polarizing plate 38 by adjusting the electrical potential difference between the pixel electrode 47 and a counterelectrode 48 for every pixel. Therefore, a gradation display is attained in the mold LCD 31 in two ways. Moreover, with the mold LCD 31 in two ways, in either reflective mode or the transparent mode a pixel becomes a white display in the condition that the electrical potential difference is not impressed between the pixel electrode 47 and the counterelectrode 48, and as explained above, since liquid crystal has the forward dielectric anisotropy, where an electrical potential difference is impressed, a pixel becomes a black display. That is, the mold LCD 31 in two ways displays the so-called normally white mold.

[0067] As for the phase contrast of the light before and behind passage of the optical path L1 until it carries out incidence to the 2nd polarizing plate 38 after 1st polarizing plate 37 passage in the transparent mode mentioned above in the mold LCD 31 in two ways of the gestalt of the 1st operation, and the phase contrast of the light before and behind passage of the optical path L2 until it carries out re-incidence to the 2nd polarizing plate 38 after 2nd polarizing plate 38 passage in the reflective mode mentioned above, it is desirable that it is in agreement. When the phase contrast of the optical path L1 of the transparent mode and the phase contrast of the optical path L2 in reflective mode are in agreement, the brightness of the pixel white-displayed at the time of the transparent mode and the brightness of the pixel white-displayed at the time of reflective mode are in agreement.

[0068] The optical path L1 of the transparent mode is an optical path which passes the 1st optical compensating plate 37, the 1st optical path L3 of the liquid crystal display component 33, and the 2nd optical compensating plate 38 in this order. The 1st optical path L3 is an optical path which passes the part in the transparency field 72 of main substrate section 33A, the liquid crystal layer 43, and the color filter layer 69 of opposite substrate section 33B in this order. It is the optical path which passes the optical path L2 38 in reflective mode, i.e., the 2nd optical compensating plate, carries out incidence to the liquid crystal display component 33 from the 2nd substrate 42 side, passes the 2nd optical path L4

of a liquid crystal display component, injects from the 2nd substrate 42 side and re-passes the 2nd optical compensating plate 38. The 2nd optical path L4 is an optical path which passes opposite substrate section 33B and the liquid crystal layer 43 in this order, is reflected in the pixel electrode reflective section 57, and re-passes the liquid crystal layer 43 and opposite substrate section 33B in this order.

[0069] As for both of phase contrast of the optical path L2 in reflective mode, and phase contrast of the optical path L1 of the transparent mode, it is most desirable to have become one-wave conditions, i.e., 2pi. Since the light which passes an optical path L1 and carries out re-incidence to the 2nd polarizing plate 36 turns into the linearly polarized light which vibrates in parallel with the transparency shaft (= polarization shaft) of the 2nd polarizing plate 36 when the phase contrast of the optical path L1 of the transparent mode is one-wave conditions, the quantity of light of the light which penetrates the 2nd polarizing plate 36 becomes max, and the brightness of the pixel white-displayed becomes max. Since similarly the light which passes an optical path L2 and carries out re-incidence to the 2nd polarizing plate 36 turns into the linearly polarized light which vibrates in parallel with the transparency shaft (= polarization shaft) of the 2nd polarizing plate 36 when the phase contrast of the optical path L2 in reflective mode is one-wave conditions, the quantity of light of the light which penetrates the 2nd polarizing plate 36 becomes max, and the brightness of the pixel white-displayed becomes max.

[0070] What is necessary is just to adjust the thickness dt of the liquid crystal layer 43 of the transparency field which is the liquid crystal layer 43 between the pixel electrode transparency section 58 and a counterelectrode 48 so that the phase contrast of the light before and behind passage of the 1st optical path L3 may become 1/2-wave conditions, i.e., pi, in order to reach on the other hand, and to make phase contrast of the optical path L1 of the transparent mode into one-wave conditions, when the 2nd optical compensating plates 37 and 38 are both quarter-wave length plates. When the 2nd optical compensating plate 38 is a quarter-wave length plate, in order to make phase contrast of the optical path L2 in reflective mode into one-wave conditions So that the phase contrast of the light after passage of the optical path L5 which passes opposite substrate section 33B and a liquid crystal layer, and results in the pixel electrode reflective section 57 may become quarter-wave length conditions (pi/2), i.e., pi for 2 minutes The thickness dr of the liquid crystal layer 43 of the reflective field which is the liquid crystal layer 43 between the pixel electrode reflective section 57 and a counterelectrode 48 is adjusted. Since the phase contrast of the light before and behind passage of the 2nd path L4 equivalent to the round trip of the optical path L5 from opposite substrate section 33B to the pixel electrode reflective section 57 becomes 1/2-wave conditions by this, the phase contrast of the optical path L2 in reflective mode becomes one-wave conditions.

[0071] In order to change partially the thickness of the liquid crystal layer 43 which intervenes between main substrate section 33A and opposite substrate section 33B, the adjustment layer 49 intervenes between the pixel electrode reflective section 57 and the 1st substrate 41. Spacing of main substrate section 33A and opposite substrate section 33B is adjusted according to the thickness dt of the liquid crystal layer 43 of a transparency field, and the thickness of the adjustment layer 49 is adjusted according to the difference of the thickness dt of the liquid crystal layer 43 of a transparency field, and the thickness dr of the liquid crystal layer 43 of a reflective field. The thickness of such an adjustment layer 49 is fully thicker than the scanning line, other components 47, for example, pixel electrode, on the 1st substrate in main substrate section 33A, 61. Therefore, the level difference produced into the part which laps with the edge of the adjustment layer 49 of the 1st orientation film 45 is large, and tends to cause a reverse tilt domain from the level difference produced into the part which laps with the edge of other components of main substrate section 33A of the 1st orientation film 45. So, with the gestalt of the 1st operation, generating of a reverse tilt domain is prevented by removing at least the wall surface which counters in the direction of reverse rubbing among the wall surfaces of the 1st orientation film 45 resulting from the edge of the adjustment layer 49.

[0072] Drawing 3 is the field for 2 pixels of main substrate section 33A of the liquid crystal display

component 33 of the mold LCD 31 in two ways of drawing 1 , and the expansion top view of the perimeter. Drawing 3 simplifies and shows the expansion top view of drawing 1 . Drawing 4 is the D–D sectional view of main substrate section 33A of drawing 3 . The D–D cross section is parallel to the direction 53 of rubbing of the 1st orientation film 45, and passes along the pixel electrode transparency section 58. two pixel electrodes 47 arrange in the field for 2 pixels of drawing 3 — having — **** — this — two pixel electrodes are in the direction 53 of rubbing as **** together with abbreviation parallel. The configuration for removing the direction 55 of reverse rubbing and the wall surface which counters from the 1st orientation film 45 of main substrate section 33A using drawing 3 and drawing 4 is explained to a detail.

[0073] In addition, it sets to the explanation using drawing 3 and drawing 4 . The pixel field 52 which is in the direction 53 of rubbing together with abbreviation parallel at the direction 53 side of rubbing of the pixel electrodes 47 of two ****** and where the pixel electrode 47 and this one side pixel electrode 47 are arranged on the other hand is described as "top pixel electrode 47A" and the "top pixel field 52." The pixel field 52 where the another side pixel electrode 47 in this reverse rubbing direction 55 side of the two pixel electrodes 47 and this another side pixel electrode 47 are arranged is described as "bottom pixel electrode 47B" and "bottom pixel field 52B." In addition, in the explanation using drawing 3 and drawing 4 , the end by the side of a member or the direction 53 of rubbing of a field is described as "upper limit", and the other end by the side of a member or the direction 55 of reverse rubbing of a field is described as a "lower limit." In addition, the "left" and the "right" are directions which both intersect perpendicularly in the direction 53 of rubbing on these specifications, and the left is rightward hard flow. Furthermore with the top view of drawing 3 , the publication of some 1st orientation film 45 is omitted.

[0074] Fundamentally, pattern formation of the adjustment layer 49 is carried out so that the wall surface which counters in the direction 55 of reverse rubbing of 1st orientation film 45 front face may decrease as much as possible. For this reason, fundamentally, the opening 50 of the adjustment layer 49 is straddling the pixel electrodes 47A and 47B of two ****** together with abbreviation parallel in the direction 53 of rubbing. That is, the upper limit of the opening 50 of the adjustment layer 49 is between top pixel electrode 47A and the 1st orientation film 45, and the lower limit of opening of the adjustment layer 49 is between bottom pixel electrode 47B and the 1st orientation film 45.

[0075] With the liquid crystal display component 33 of the mold in two ways, the adjustment layer 49 intervenes between the pixel electrode reflective section 57 and the 1st substrate 41, and the opening 50 of the adjustment layer 49 is arranged in the location which sees from [of the 1st substrate 41] a normal and laps with the pixel electrode transparency section 58. For this reason, the adjustment layer 49 is seen from [of 1st substrate 41 front face] a normal, and exists only in the field (a "reflective border area" is called henceforth) 75 and the reflective field 71 which were inserted into the reflective field 71 of two pixel fields 52. The opening 50 of the adjustment layer 49 is seen from [of 1st substrate 41 front face] a normal, and it is formed so that it may be in agreement with the transparency field 72 of the field (a "transparency border area" is called henceforth) 76 inserted into the transparency field 72 of top pixel electrode 52A, and the transparency field 72 of bottom pixel field 52B, top pixel field 52A, and bottom pixel field 52B. In addition, in drawing 3 , the slash is given to the reflective border area 75 and the transparency border area 76.

[0076] With the gestalt of the 1st operation, pattern formation of the adjustment layer 49 is carried out so that both wall surfaces which counter in the wall surface and the direction 53 of rubbing which counter in the direction 55 of reverse rubbing may arise on the 1st orientation film 45. For this reason, the transparency field 72 is formed in the band–like field from the upper limit 73 of this pixel field 52 to a lower limit 74 in the single pixel field 52. Of this, the opening 50 of the adjustment layer 49 is seen from [of the 1st substrate 41] a normal, and it is formed so that the lower limit of bottom pixel electrode 47B may be reached [from the upper limit of top pixel electrode 47A]. That is, the upper limit of the opening 50 of the adjustment layer 49 laps with the upper limit of top pixel electrode 47A, and the lower

limit of this opening 50 laps with the lower limit of bottom pixel electrode 47B. Opening which laps with the pixel electrode which the opening 50 of such a configuration is repeatedly formed per pixel, and is located in a line with one train in ********** and the direction of rubbing at abbreviation parallel carries out sequential continuation, and turns into one opening.

[0077] Furthermore, as for the transparency field 72 of the single pixel field 72, the side edge on either side is the direction 53 of rubbing, and abbreviation parallel. The right-hand side edge of top pixel field 52A is located on the production of the right-hand side edge of bottom pixel field 52B, and the left-hand side edge of top pixel field 52A is located on the production of the left-hand side edge of bottom pixel field 52B. The transparency field 72 of the pixel field 52 where the transparency field 72 of such a configuration is repeated per pixel, and is located in a line with abbreviation parallel in ********** and the direction of rubbing at one train, and the transparency border area 76 between these transparency fields 72 carry out sequential continuation, and a side edge on either side becomes the direction 53 of rubbing, and one strip region which is abbreviation parallel. since opening 50 should just be formed so that it may lap with said strip region without the need of arranging the adjustment layer 49 — the direction 53 of rubbing, and a longitudinal direction — abbreviation — it becomes possible to carry out pattern formation of the adjustment layer 49 to the piece of the film of the shape of an parallel stripe. The edge of the adjustment layer 49 becomes the direction 55 of reverse rubbing, and abbreviation parallel, and the edge which counters in the direction 55 of reverse rubbing stops existing in the adjustment layer 49 by this.

[0078] a longitudinal direction — the direction 53 of rubbing, and abbreviation — when the 1st orientation film 45 is formed on the adjustment layer 49 formed in band-like [parallel], the wall surface which originates in the edge of the adjustment layer 49 and counters 1st orientation film 45 front face in the direction 55 of reverse rubbing does not exist. When the adjustment layer 49 is formed so that not only the wall surface that counters in the direction 53 of reverse rubbing but the wall surface which counters in the direction 53 of rubbing may be removed from 1st orientation film 45 front face as explained above, since the adjustment layer 49 should just be formed in band-like, the pattern formation of the adjustment layer 49 becomes easy.

[0079] When the liquid crystal display component 33 of the mold in two ways of the gestalt of the 1st operation explained by drawing 1 - drawing 4 is compared with the liquid crystal display component of the mold in two ways of the 1st conventional technique explained by drawing 7 and drawing 8 , a difference is in the following configurations.

[0080] The configuration of those other than the adjustment layer of the liquid crystal thickness of the mold liquid crystal display component in two ways of the 1st conventional technique and the 1st orientation film is equal to the mold liquid crystal display component 33 in two ways of the gestalt of the 1st operation. That is, in the one side front face by the side of the liquid crystal layer of the 1st substrate of the liquid crystal display component of the 1st conventional technique, it is arranged so that the scanning line and a signal line may intersect perpendicularly mutually, and an interlayer insulation film is arranged between the scanning line and a signal line. The pixel electrode reflective section 7 is arranged to the reflective field 5 in the pixel field 3 which is a rectangle field classified with the scanning line and a signal line, and the pixel electrode transparency section 6 is arranged to the transparency field 4 in the pixel field 3. The orientation film is formed by applying the ingredient of the 1st orientation film 45 on the 1st substrate 2 after pixel electrode 8 formation of the above-mentioned configuration, and carrying out rubbing of the thin film formed by this in the predetermined direction 53 of rubbing. Such the main substrate section 1 of a configuration is ******(ed) by the opposite substrate section equal to the configuration explained by drawing 2 through the parallel orientation liquid crystal layer whose dielectric anisotropy is forward. Also in the 1st conventional technique, in order to make in agreement the retardation (phase contrast) of the transparency field of the mold LCD in two ways, and the retardation of the reflective field of the mold LCD in two ways, the thickness of the adjustment layer 9 has one half extent of the thickness of the liquid crystal layer of a transparency field.

[0081] In the 1st conventional technique, the reflective field 5 is "opening" mold and encloses the transparency field 4. Therefore, it sees from [of the 1st substrate 2] a normal, and the wall surface 25 which counters in the direction 55 of reverse rubbing exists in the location which laps with the boundary of the reflective field 5 of the 1st orientation film front face of the 1st conventional technique, and the transparency field 4, and since the level difference of this wall surface 25 is larger than ten percent of the maximum thickness of the part which counters the pixel electrode of a liquid crystal layer, the reverse tilt domain 26 occurs on this about 25 wall surface. Consequently, since the disclination line 27 is generated between a field with the wall surface 25 which counters the direction 18 of rubbing, and an opposite direction, and the field as for which the liquid crystal molecule is carrying out orientation normally, the contrast and the speed of response of the mold LCD in two ways fall. Consequently, the display grace of the mold LCD in two ways falls.

[0082] Since the wall surface which originates in the adjustment layer 49 and counters in the direction 55 of reverse rubbing does not exist in the front face of the 1st orientation film 45 of the liquid crystal display component 33 of the gestalt of the 1st operation shown in drawing 1 – drawing 4 , the reverse tilt domain and disclination line resulting from this wall surface do not occur. The liquid crystal display component 33 of the gestalt of the 1st operation can carry out orientation of the liquid crystal molecule in the liquid crystal layer 43 to homogeneity by this. Therefore, since the contrast and the speed of response of the mold LCD 31 in two ways of the 1st operation improve rather than the 1st conventional technique, the display grace of the mold LCD 31 in two ways of the gestalt of the 1st operation improves rather than the display grace of the mold LCD in two ways of the conventional technique. [of a gestalt]

[0083] When the level difference of the orientation membranous wall side which counters in the direction 55 of reverse rubbing is larger than height of ten percent of the maximum thickness dt of the part which counters the pixel electrode 47 of the liquid crystal layer 23, this orientation membranous wall side causes disclination. If a level difference is height of ten or less percent of said maximum thickness dt more greatly than 0, even if the orientation membranous wall side which counters in the direction 55 of reverse rubbing remains in 1st orientation film 45 front face, it will not affect the display grace of LCD. For example, in the mold LCD 31 in two ways of drawing 1 – drawing 4 , the orientation membranous wall side which counters in the orientation membranous wall side which counters in the direction 55 of reverse rubbing, or the direction 53 of rubbing remains in the location with which the edge of the scanning line 61 and the edge of the pixel electrode transparency section 58, and the 1st orientation film 45 lap. Since the level difference of the wall surface which is as ******** is 0.3 micrometers or less in at most 0.1-micrometer or more height and the thickness dt of the transparency section of the liquid crystal layer 23 is 5.0 micrometers, it originates in the level difference which remains and a reverse tilt domain does not occur.

[0084] Thus, since generating of disclination and a reverse tilt domain will be prevented if the level difference of this wall surface may be stopped by ten or less percent of the maximum thickness dt of the pixel section of the liquid crystal layer 23 more greatly than 0 when the wall surface which counters in the direction 55 of reverse rubbing remains in the orientation film front face, homogeneity can be made to carry out orientation of the liquid crystal molecule in the liquid crystal layer 43 to sufficient extent for a good display. Therefore, instead of carrying out patterning of the adjustment layer so that the edge which counters in the direction 55 of reverse rubbing may not exist, the components between the 1st orientation film 45 and a substrate 41 may be constituted so that the level difference of an orientation membranous wall side may become ten or less percent of the maximum thickness dt from 0 greatly.

[0085] When the taper angle of the member between the 1st orientation film 45 and the 1st substrate 41 is the include angle of under the pre tilt angle of a liquid crystal molecule [as opposed to / it is larger than 0 times and / the 1st substrate 41], the orientation of the liquid crystal molecule near the wall surface of the 1st orientation film 45 of a wrap does not become a reverse tilt about the edge of

this member. Since a pre tilt angle is generally one – 9 times, the taper angle of a member has become more than the pre tilt angle. In the orientation membranous wall side which has a predetermined level difference, it is hard coming to generate disclination, so that the taper angle of a wrap member edge is [this wall surface] small.

[0086] This applicant manufactured the mold LCD in two ways equipped with the liquid crystal display component 33 of the gestalt of the 1st operation, and the mold LCD in two ways equipped with the liquid crystal display component of the 1st conventional technique, respectively, and observed the display condition of both mold LCD in two ways. The 1st detail configuration of the mold LCD in two ways of the gestalt of operation is a configuration of having been explained by the production process mentioned above. Unlike the mold LCD in two ways of the gestalt of the 1st operation, other configurations have [the detail configuration of the mold LCD in two ways of the 1st conventional technique] only the flat-surface configuration of an adjustment layer and a pixel electrode equal to the mold LCD in two ways of the gestalt of the 1st operation. When the mold LCD in two ways of the 1st conventional technique was observed using the optical microscope from the front-face side, generating of a disclination line was checked near the part where the orientation membranous wall side which counters in the direction of reverse rubbing exists. The disclination line was not generated when the mold LCD in two ways of the gestalt of the 1st operation was observed using the optical microscope from the front-face side.

[0087] Further, this applicant measured the contrast of the mold LCD in two ways of the 1st conventional technique, and the contrast of the mold LCD in two ways of the gestalt of the 1st operation, respectively, and compared them. Consequently, the contrast of the mold LCD in two ways of the gestalt of the 1st operation was improving 10% to 20% rather than the contrast of the mold LCD in two ways of the 1st conventional technique. This is based on the following reasons. Since a disclination line generates the optical leakage from a pixel in case it indicates the pixel by black, it causes [of the mold LCD in two ways] a contrast fall. Since the disclination line had not occurred in the mold LCD in two ways of the gestalt of the 1st operation and the optical leakage resulting from a disclination line was lost, the mold LCD contrast in two ways of the gestalt of the 1st operation is improving.

[0088] Thus, in the mold LCD in two ways equipped with the liquid crystal display component 33 of the gestalt of the 1st operation, display grace is improving from the mold LCD in two ways equipped with the liquid crystal display component of the 1st conventional technique. The configurations of the liquid crystal display component 33 of the gestalt of the 1st operation and the liquid crystal display component of the 1st conventional technique differ only in the flat-surface configuration of the adjustment layer 49 and the pixel electrode 47. Therefore, minute modification is only added to the configuration and production process of a liquid crystal display component of the conventional technique, and since the design of the liquid crystal display component 33 of the gestalt of the 1st operation and the design of a production process are possible, implementation of the liquid crystal display component 33 of the gestalt of the 1st operation is easy.

[0089] In addition, with the gestalt of the 1st operation, parallel orientation processing is performed to the 1st orientation film 45. Perpendicular orientation processing may be performed not only to this but to the 1st orientation film 45. The formation technique of the 1st orientation film 45 accompanied by perpendicular orientation processing is as follows. First, it consists of an ingredient of the perpendicular orientation film, and on the 1st substrate 41 after pixel electrode 47 formation, the thin film whose thickness is 80nm uses a printing technique, and is formed. The ingredient of the perpendicular orientation film is JALS2004 by Japan Synthetic Rubber Co., Ltd. The thin film after membrane formation is calcinated at 180 degrees for 2 hours. Rubbing of the front face of the thin film after baking is carried out in the direction 53 of rubbing with the rubbing roller which twisted the cloth made from rayon. The rotational frequency of the rubbing roller at the time of rubbing processing is 100rpm, and the passing speed of the substrate to a roller is 100mm per minute (100 mm/mim). The 1st orientation film 45 with which perpendicular orientation processing was performed by this is completed. Even when

perpendicular orientation processing is performed to the 1st orientation film 45, the display grace of the mold LCD 31 in two ways as well as the case where parallel orientation processing is performed improves.

[0090] Drawing 5 is the expansion part plan where the field for 2 pixels of the main substrate section 101 which the liquid crystal display component which is the gestalt of operation of the 2nd of this invention has, and its perimeter were simplified. Drawing 6 is the E-E sectional view of the main substrate section 101 of drawing 5 . Drawing 5 and drawing 6 are doubled and explained. In addition, the liquid crystal display component of the gestalt of the 2nd operation has composition which transposed main substrate section 33A of the liquid crystal display component 33 of the gestalt of the 1st operation to the main substrate section 101 of drawing 5 . The same reference mark is given to the components which have the function same among the components of the main substrate section 101 of drawing 5 as the components of main substrate section 33A of drawing 1 , and explanation is omitted. In addition, in the explanation using drawing 5 and drawing 6 , the definition of "top pixel electrode 47A", the "top pixel field 52", "bottom pixel electrode 47B", "bottom pixel field 52B", "upper limit", a "lower limit", the "right", and the "left" is equal to the definition in explanation of drawing 3 and drawing 4 . two pixel electrodes 47 arrange in the field for 2 pixels of drawing 5 R> 5 — having — **** — this — two pixel electrodes are in the direction 53 of rubbing as **** together with abbreviation parallel. The E-E cross section is parallel to the direction 53 of rubbing of the 1st orientation film 45, and passes along the pixel electrode transparency section 58. Furthermore, with the top view of drawing 5 , the publication of a part of 1st orientation 45 is omitted, and the slash is given to the reflective border area and the transparency border area.

[0091] The main substrate section 101 of drawing 5 has the composition of having added the addition capacity wiring 103 for the addition part by volume 103 to each pixel field 52 of main substrate section 33A of drawing 1 . The part which the addition capacity wiring 103 superimposes on the pixel electrode 47 through an interlayer insulation film 63 functions as an addition part by volume 104. The addition capacity wiring 103 is arranged between an interlayer insulation film 63 and the 1st substrate 41 so that it may become the direction and parallel to which, as for the addition capacity wiring 103, a passage and the direction 53 of rubbing and a longitudinal direction cross at right angles with the gestalt of this operation about the center section of the pixel field 52. In the location which sees from [of the 1st substrate 41] a normal and laps with the addition capacity wiring 103, the extension section of the pixel electrode transparency section 58 and the pixel electrode reflective sections 57 overlap through the adjustment layer 49. The contact hole 105 is established in the adjustment layer 49 between the reflective section 57 and the transparency section 58 extension section, and the extension section of the pixel electrode transparency section 58 and the pixel electrode reflective section 57 are connected through the contact hole 105. The mold LCD in two ways equipped with such the main substrate section 101 which has the liquid crystal display component of the mold in two ways of the gestalt of the 2nd operation has composition which transposed the liquid crystal display component 33 of the mold LCD 31 in two ways of the gestalt of the 1st operation to the liquid crystal display component of the gestalt of the 2nd operation.

[0092] Since the addition capacity wiring 103 is formed from the conductive ingredient which generally has protection-from-light nature, it is difficult to use the field where the addition capacity wiring 103 has been arranged as a transparency field 72. For this reason, with the gestalt of the 2nd operation, the pixel electrode reflective section 57 is formed in the shape of "H", and the field where the addition capacity wiring 103 has been arranged is included to the reflective field 71. As a result in the single pixel field 52, the transparency field 72 is divided by two, the 1st field 111 where upper limit has lapped with the upper limit 73 of the pixel field 52, and the 2nd field 112 where the end has lapped with the lower limit 74 of the pixel field 52.

[0093] In order that the adjustment layer 49 may decrease the number of the wall surfaces which counter in the direction 55 of reverse rubbing in the 1st orientation film 45 as much as possible, in the

field 113 to which the pixel electrodes 47A and 47B of two ****** have been arranged together with abbreviation parallel in the direction 53 of rubbing, the adjustment layer 49 is formed so that a part with the equal height from 1st substrate 41 front face of 1st orientation film 45 front face may continue. For this reason, the opening 50 of the adjustment layer 49 is straddling the pixel electrodes 47A and 47B of two ****** together with abbreviation parallel in the direction of rubbing.

[0094] the configuration of drawing 5 — concrete — the 1st field 111 of bottom pixel field 52B, and the 2nd field 112 of top pixel field 52A — this — since it is in contact with the transparency border area 76 between [of two] pixel field 52A and 52B, respectively, these three fields 111, 112, and 76 form the single field continuously. The opening 50 of the adjustment layer 49 was seen from [of the 1st substrate 41] the normal, and has lapped with the single field formed from these three fields 111, 112, and 76. By this, in the 1st orientation film 45 front face in the field 113 where a top and the bottom pixel electrodes 52A and 52B have been arranged, 1st substrate 41 the part with the equal height from the field which gets drunk Since it continues mutually across the pixel field 52, together with abbreviation parallel, the wall surface which counters in the direction 55 of reverse rubbing does not exist in the field between the pixel fields 52 of two ******, and its near in the direction 53 of rubbing. In the front face of the part which is in the single pixel field 52 of the 1st orientation film 52 as a result, the wall surface 108 which counters in the wall surface 107 and the direction 53 of rubbing which counter in the direction 55 of reverse rubbing originates only in the edge of the part which laps with the addition capacity wiring 103 of the adjustment layer 49, and is produced.

[0095] When the main substrate section 101 of the liquid crystal display component of the gestalt of the 2nd operation shown in drawing 5 and drawing 6 is compared with the main substrate section 13 of the liquid crystal display component of the 2nd conventional technique shown in drawing 9 and drawing 10 , a difference is in the following configurations. In the main substrate section 13 of the 2nd conventional technique, since the flat-surface configuration of a reflective field is the character type of "8", the adjustment layer 9 is arranged not only around the reflective field 7 but around [four way type / whole] a pixel field. Two wall surfaces which counter in the direction 53 of reverse rubbing exist in the front face of the part which is in the single pixel field 8 of the orientation film 11 of the main substrate section 13 of the 2nd conventional technique as a result. In the main substrate section 101 of the gestalt of the 2nd operation, the flat-surface configuration of the reflective field 71 is the "H" mold, and the adjustment layer 49 is removed not only from the transparency field 72 but from the transparency border area 76. Only one wall surface which counters in the direction 53 of reverse rubbing in the front face of the part which is in the single pixel field 52 of the orientation film 45 of the main substrate section 101 of the gestalt of the 2nd operation as a result exists on the addition capacity wiring 103.

[0096] Thus, the number of the orientation membranous wall sides which counter in the direction 53 of reverse rubbing in the main substrate section 101 of the gestalt of the 2nd operation is half [which counters in the direction 53 of reverse rubbing in the main substrate section 13 of the 2nd conventional technique / a number of an orientation membranous wall side of]. Since the part which the disclination line in the liquid crystal display component which has the main substrate section 101 of the gestalt of the 2nd operation in this way by this may generate is reduced by half rather than the part which the disclination line in the liquid crystal display component which has the main substrate section 13 of the 2nd conventional technique may generate, the display grace of the liquid crystal display component of the gestalt of the 2nd operation improves rather than the display grace of the liquid crystal display component of the 2nd conventional technique. Thus, the liquid crystal display component of the gestalt of the 2nd operation can prevent the reverse tilt in the pixel field periphery section, without almost changing the area of the pixel electrode reflective section from the conventional technique.

[0097] In addition, the wall surface which counters in the direction 55 of reverse rubbing, and the wall surface which counters in the direction 53 of rubbing remain in the field to which the edge of the scanning line 61 and the edge of the pixel electrode transparency section 58, and the 1st orientation film 45 lap with the 1st orientation film 45 of the main substrate section 101 of the gestalt of the 2nd

operation. Since it turns out that it originates in the level difference which remains based on the reason explained with the gestalt of the 1st operation, and a reverse tilt domain does not occur since the level difference of the wall surface which is as ******** is 0.3 micrometers or less in at most 0.1-micrometer or more height and the thickness dt of the transparency section of the liquid crystal layer 23 is 5.0 micrometers, deterioration of the display grace resulting from these level differences does not take place.

[0098] The 1st and the liquid crystal display component of the gestalt of the 2nd operation are instantiation of the liquid crystal display component of this invention, and if main configurations are equal, they are realizable with other various configurations. Especially the detailed configuration of each component part of a liquid crystal display component may be realized by not only an above-mentioned configuration but other configurations if the same effectiveness is acquired.

[0099] For example, as long as the adjustment layer 49 has composition which is arranged only in the reflective field 71 and the reflective border area 76, and is removed from the transparency field 72 and the transparency border area 76 among the component parts of the liquid crystal display component of the mold in two ways, the configurations of other components may be not only the configuration explained with the gestalt of the 1st and the 2nd operation but other configurations. Since it is formed by the 1st orientation film 45 of the main substrate section of the liquid crystal display component of the mold in two ways so that the wall surface which counters in the direction 55 of reverse rubbing may decrease as much as possible by this, deterioration of the display grace of the mold LCD in two ways resulting from a disclination line and a reverse tilt domain is suppressed.

[0100] Moreover, although the mold LCD in two ways has composition using a polarizing plate since the 1st and the liquid crystal display component of the gestalt of the 2nd operation are TN mold or a STN mold, liquid crystal display components may be not only this but other configurations, for example, GH mold. Even if the mold LCD in two ways is the configuration of not using a polarizing plate, it is desirable like the mold LCD in two ways of the gestalt of the 1st and the 2nd operation to make in agreement the effectual thickness of the liquid crystal layer transparency section and the effectual thickness of the liquid crystal layer reflective section. That is, it is desirable that the phase contrast of the light before and behind 1st optical-path L3 passage of the liquid crystal layer transparency section adjusts the thickness dr of the liquid crystal layer reflective section using the adjustment layer 49 so that it may be in agreement with the phase contrast of the light before and behind 2nd optical-path L4 passage of the liquid crystal layer reflective section. For example, if the effectual thickness of the liquid crystal layer transparency section is in agreement with the effectual thickness of the liquid crystal layer reflective section when a liquid crystal display component is GH mold, the dichroic ratio in the liquid crystal layer transparency section and the dichroic ratio in the liquid crystal layer reflecting layer section can be doubled.

[0101] Moreover, as long as the liquid crystal display component formed so that the wall surface which counters in the direction 55 of reverse rubbing of orientation film 45 front face might decrease as much as possible is a liquid crystal display component which has the orientation film with which rubbing processing was performed as orientation processing, it may be the liquid crystal display component of not only the mold liquid crystal display component in two ways but other molds, for example, a projection mold liquid crystal display component. The orientation membranous wall side which furthermore serves as a candidate for removal may cover the edge of a member like the throat between not only a wrap wall surface but the orientation film, and substrates for the edge of the adjustment layer 49. Although the orientation film of the object which removes a level difference is furthermore using the 1st orientation film 45 of the main substrate sections 33A and 101 as the orientation film for level difference removal with the gestalt of the 1st and the 2nd operation If the wall surface which has the level difference of ten percent or more of the maximum thickness dt of the part which counters the pixel field 52 of a liquid crystal layer on the 2nd orientation film 46 of opposite substrate section 33B, and counters it in the direction of reverse rubbing arises on the 2nd orientation film 46 of opposite

substrate section 33B A wall surface may be removed from opposite substrate section 33B by the wall surface removal technique from the main substrate sections 33A and 101, and the same technique.
[0102] When seeing from [of the 1st substrate 41] a normal and lapping in the direction of rubbing together with abbreviation parallel with the adjustment layer opening 50 with the single transparency field 72 of the pixel electrodes 47A and 47B of two ******, In each right and left, the thing short as much as possible of the distance of the rectangular direction of the direction 53 of rubbing from the side edge of right and left of the transparency field 72 of top pixel field 52A to the production of the side edge of right and left of the transparency field 72 of bottom pixel field 52B is desirable. This is based on the following reasons. When the side edge of right and left of the transparency field 72 of top pixel field 52A has shifted from the production of the side edge of right and left of the transparency field 72 of bottom pixel field 52B, the part which counters in the direction 55 of reverse rubbing exists in the side edge of right and left of opening 50, and this part becomes the cause which the wall surface which counters an orientation film front face in the direction 55 of reverse rubbing produces. Since the part which counters in the direction 55 of reverse rubbing of the side edge of right and left of opening 50 becomes small so that the distance of the longitudinal direction from the side edge of right and left of the transparency field 72 of top pixel field 52A to the side edge production of right and left of the transparency field 72 of bottom pixel field 52B is small, the orientation membranous wall side which counters in the direction 55 of reverse rubbing becomes small, and the effect which it has on the orientation of a liquid crystal molecule becomes small.
[0103] As for at least one side of the side edges of right and left of the opening 50 of the adjustment layer 49, in the 1st and the liquid crystal display component of the gestalt of the 2nd operation, it is most desirable that they are the direction 53 of rubbing and abbreviation parallel. What is necessary is just to set distance of the longitudinal direction from the side edge of right and left of the transparency field 72 of top pixel field 52A to the side edge production of right and left of the transparency field 72 of bottom pixel field 52B to 0, in order to make abbreviation parallel the side edge of right and left of the opening 50 of the adjustment layer 49 with the direction 53 of rubbing. By this, it stands in a line in parallel with the direction of rubbing, and the orientation membranous wall side which counters with the opposite direction of the direction of rubbing between the pixel electrodes of two ****** does not exist. Therefore, a liquid crystal display component can prevent deterioration of the display grace resulting from disclination still more certainly.
[0104]
[Effect of the Invention] According to this invention, in a liquid crystal display component, the interlayer film and pixel electrode which have opening between the 1st substrate and the 1st orientation film are arranged as mentioned above. Opening of an interlayer film is formed so that the wall surface which counters the direction of rubbing and an opposite direction may not exist in the 1st orientation film. Deterioration of the display grace of a liquid crystal display component is prevented by this. Moreover, according to this invention, in a liquid crystal display component, both wall surfaces which originate in an interlayer film and counter the 1st orientation film by the side of the 1st substrate in the opposite direction of the direction of rubbing and the direction of rubbing exist. The edge of the interlayer film leading to the wall surface which counters said opposite direction by this can be lost easily and completely.
[0105] Moreover, as mentioned above, according to this invention, in the liquid crystal display component, opening of an interlayer film is prepared so that a part with equal height may continue from the substrate front face of said 1st orientation film in the field where it stood in a line in parallel with the direction of rubbing, and each pixel electrode of two ****** has been arranged. Thus, since the liquid crystal display is constituted so that the wall surface which counters the opposite direction of the direction of rubbing may be reduced as much as possible, a liquid crystal display component can prevent deterioration of display grace certainly.
[0106] As mentioned above, according to this invention, in the liquid crystal display component, opening

of an interlayer film is formed further again so that the pixel electrode of two ****** may be straddled together with abbreviation parallel in the direction of rubbing. Since it is continuing without the field with which a pixel electrode and an interlayer film do not lap by this becoming independent for every pixel, the liquid crystal display component is constituted so that the wall surface which counters the opposite direction of the direction of rubbing may be reduced as much as possible. Therefore, deterioration of the display grace of a liquid crystal display component is prevented certainly.

[0107] moreover, according to this invention, opening of an interlayer film is in said direction of rubbing together with abbreviation parallel at the direction side of rubbing of the pixel electrodes of two ****** -- on the other hand — from the edge by the side of the direction of rubbing of a pixel electrode — this -- the edge by the side of this opposite direction of the another side pixel electrode in this opposite direction side of the two pixel electrodes is reached. A liquid crystal display component can prevent deterioration of display grace further by this. According to this invention, in the liquid crystal display component, the edges by the side of the direction which intersects perpendicularly in the direction of rubbing of opening of an interlayer film are abbreviation parallel in the direction of rubbing further again. A liquid crystal display component can prevent deterioration of display grace still more certainly by this. Moreover, according to this invention, in the liquid crystal display component, the level difference of the wall surface which has countered to the opposite direction of the direction of rubbing of the 1st orientation film by the side of the 1st substrate is larger than 0, and has become the value of less than ten percent of the maximum thickness of the part which counters the pixel electrode of a liquid crystal layer. A liquid crystal display component can prevent deterioration of display grace certainly by this.

[0108] According to this invention, a liquid crystal display component is a mold both for transparency reflective, and the interlayer film is used for adjustment of the phase contrast of the light before and behind passage of the optical path of the light used for a display further again. Since generating of the wall surface which originates in an interlayer film and counters the opposite direction of the direction of rubbing is suppressed as much as possible, as for the liquid crystal display component of the mold in two ways, deterioration of display grace can be prevented.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] They are the field for 1 pixel of main substrate section 33A which the liquid crystal display component 33 which is the gestalt of operation of the 1st of this invention has, and the expansion part plan of the perimeter.

[Drawing 2] It is the partial expanded sectional view of the mold LCD 31 in two ways equipped with the liquid crystal display component 33 of drawing 1 .

[Drawing 3] It is the expansion part plan where the field for 2 pixels of main substrate section 33A of

the liquid crystal display component 33 of drawing 1 and its perimeter were simplified.
[Drawing 4] It is the D–D sectional view of the field for 1 pixel of main substrate section 33A of the liquid crystal display component 33 of drawing 3 .
[Drawing 5] It is the expansion part plan where the field for 2 pixels of the main substrate section 101 which the liquid crystal display component which is the gestalt of operation of the 2nd of this invention has, and its perimeter were simplified.
[Drawing 6] It is the E–E sectional view of the field for 1 pixel of the main substrate section 101 of the liquid crystal display component of drawing 5 .
[Drawing 7] It is the expansion part plan where the field for 2 pixels of the main substrate section 1 which the liquid crystal display component of the 1st conventional technique has, and its perimeter were simplified.
[Drawing 8] It is the A–A sectional view of the field for 1 pixel of the main substrate section 1 of the liquid crystal display component of drawing 7 .
[Drawing 9] It is the expansion part plan where the field for 2 pixels of the main substrate section 13 which the liquid crystal display component of the 2nd conventional technique has, and its perimeter were simplified.
[Drawing 10] It is the B–B sectional view of the field for 1 pixel of the main substrate section 13 of the liquid crystal display component of drawing 9 .
[Description of Notations]
41 1st Substrate
42 2nd Substrate
43 Liquid Crystal Layer
45 1st Orientation Film
46 2nd Orientation Film
47 Pixel Electrode
48 Counterelectrode
49 Adjustment Layer
50 Opening of Adjustment Layer
52 Pixel Field
53 The Direction of Rubbing
55 Opposite Direction of the Direction of Rubbing
54 End Face of 1st Orientation Film
57 Reflective Section of Pixel Electrode
58 Transparency Section of Pixel Electrode
71 Reflective Field of Pixel Field
72 Transparency Field of Pixel Field
75 Reflective Border Area
76 Transparency Border Area
dt The maximum thickness of the part which counters the pixel electrode of a liquid crystal layer

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[Translation done.]

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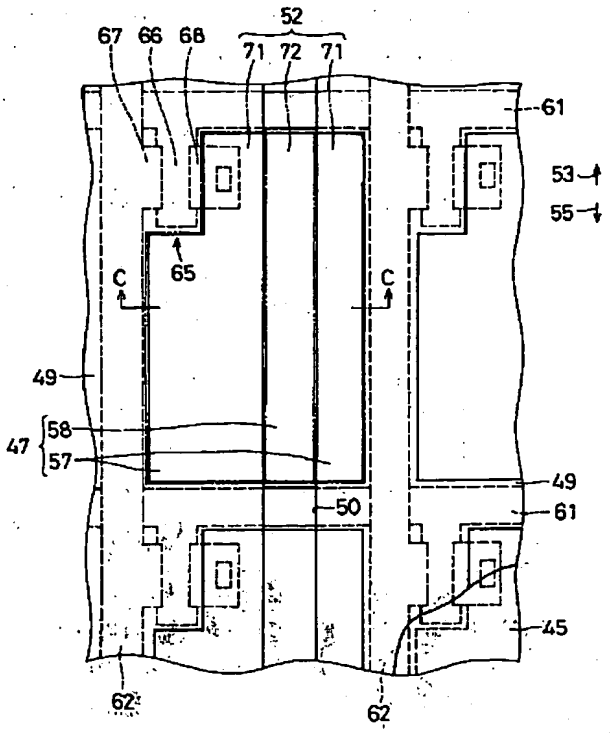
最終頁に続く

(54)【発明の名称】液晶表示素子

(57)【要約】
【課題】　配向不良に起因する液晶表示素子の表示品位の低下を防止する。
【解決手段】　液晶表示素子３３において、液晶層４３が第１基板４１と第２基板４２との間に介在され、第１配向膜４５が第１基板４１と液晶層４３との間に介在され、開口部５０を有する調整層４９と複数の画素電極４７とが第１基板４１と第１配向膜４５との間に介在される。第１基板４１の法線方向から見て、開口部５０は、ラビング方向に略平行に並んで隣合う２つの画素電極４７にまたがるように、形成されている。これによって第１配向膜４５の壁面がラビング方向５３の反対方向５５以外の方向に対して対向し、またはラビング方向に略平行に並んで隣合う２つの画素電極４７が配置された領域内にある第１配向膜４５表面の第１基板４１表面からの高さが等しい部分が連続する。これによって第１配向膜４５の段差に起因する液晶表示素子の表示品位の低下が防止される。



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【特許請求の範囲】

【請求項１】 間隔を空けて相互に対向する第１基板および第２基板と、

第１基板と第２基板との間に配置される液晶層と、

第１基板と液晶層との間に配置される第１配向膜と、

第１基板と第１配向膜との間に配置される複数の画素電極と、

第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、

第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、

層間膜の開口部の一部分は、画素電極に重なり、

前記第１配向膜の段差が生じでいる部分の表面である壁面は、ラビング方向の反対方向以外の方向に対して対向していることを特徴とする液晶表示素子。

【請求項２】 前記第１配向膜の壁面は、前記ラビング方向の反対方向およびラビング方向以外の方向に対して対向していることを特徴とする請求項１記載の液晶表示素子。

【請求項３】 間隔を空けて相互に対向する第１基板および第２基板と、

第１基板と第２基板との間に配置される液晶層と、

第１基板と液晶層との間に配置される第１配向膜と、

第１基板と第１配向膜との間に配置される複数の画素電極と、

第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、

第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、

層間膜の開口部の一部分は、画素電極に重なり、

ラビング方向に略平行に並んで隣合う２つの画素電極が配置された領域内にある第１配向膜表面の第１基板表面からの高さが等しい部分は、連続していることを特徴とする液晶表示素子。

【請求項４】 間隔を空けて相互に対向する第１基板および第２基板と、

第１基板と第２基板との間に配置される液晶層と、

第１基板と液晶層との間に配置される第１配向膜と、

第１基板と第１配向膜との間に配置される複数の画素電極と、

第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、

第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、

前記層間膜の開口部は、ラビング方向に略平行に並んで隣合う２つの画素電極にまたがって重なっていることを特徴とする液晶表示素子。

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【請求項５】 前記層間膜の開口部は、前記ラビング方向に略平行に並んで隣合う２つの画素電極のうちのラビング方向側にある一方画素電極のラビング方向側の端から、該２つの画素電極のうちの該反対方向側にある他方画素電極の該反対方向側の端に至っていることを特徴とする請求項４記載の液晶表示素子。

【請求項６】 前記層間膜の開口部のラビング方向に直交する方向側の端は、ラビング方向と略平行であることを特徴とする請求項４記載の液晶表示素子。

【請求項７】 前記第１配向膜の段差が生じている部分の表面である壁面のうち、前記ラビング方向に対して対向している壁面の段差は、前記液晶層の前記画素電極に対向する部分の最大層厚の１割未満であることを特徴とする請求項４記載の液晶表示素子。

【請求項８】 前記画素電極は、光を透過する透過部と、前記液晶層側から到来する光を反射する反射部とから構成され、

前記層間膜は、前記画素電極の反射部と前記第１基板との間に配置され、

前記層間膜の開口部は、前記画素電極の透過部と重なり、

前記第１基板と前記画素電極透過部と前記液晶層と前記対向電極と前記第２基板とを順次通過する第１光路を通過した光、および前記第２基板と前記対向電極と前記液晶層とを通過し前記画素電極反射部で反射されて前記液晶層と前記対向電極と前記第２基板とを再通過する第２光路を通過した光のうちの少なくとも一方が、表示に用いられ、

第１光路の通過前後の光の位相差と第２光路の通過前後の光の位相差とが一致するように、前記層間膜の膜厚が設定されていることを特徴とする請求項１～７のいずれかに記載の液晶表示素子。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、配向膜の形成時にラビング処理を行う液晶表示素子に関する。

【０００２】

【従来の技術】液晶表示装置は、薄型でありかつ消費電力が低いという特徴を生かして、ワードプロセッサやパーソナルコンピュータ等のＯＡ機器、電子手帳等の携帯情報機器、およびモニタを備えたカメラ一体型ビデオテープレコーダ（ＶＴＲ）等に、広く用いられている。液晶表示装置は、複数の画素が行列状に配置されて構成された液晶表示素子を少なくとも備えている。液晶表示装

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置は、陰極線管およびＥＬ表示装置に代表される自発光型の表示装置とは異なり、液晶表示素子外部からの光を利用して表示を行う。透過型の液晶表示装置では、蛍光管等で実現される背面光源が液晶表示素子の背面に配置されており、背面光源から発せられて液晶表示素子に入射する光が表示に利用される。反射型の液晶表示装置では、液晶表示素子の背面に反射板が配置されており、液晶表示素子の前面から液晶表示素子に入射する外光が表示に利用される。

【０００３】透過型液晶表示装置は、背面光源を用いて表示を行うので、装置周囲の明るさに影響されることなく、明るくコントラストが高い表示を行うことができる。背面光源の消費電力は透過型液晶表示装置の全消費電力の５０％以上を占めるので、透過型液晶表示装置全体の消費電力は大きくなりやすい。また透過型液晶表示装置は、極端に明るい環境下におかれた場合、たとえば晴天下では、視認性が低下しやすい。反射型液晶表示装置は、背面光源を使用しないので、装置全体の消費電力を大幅に少なくすることができる。反射型液晶表示装置は、装置周囲の明るさ等、使用環境に応じて、表示の明るさおよびコントラストが左右される。

【０００４】本願出願人は、透過型および反射型液晶表示装置の問題点を解決するために、透過型と反射型との両方の機能を合わせ持った透過反射両用型液晶表示装置（以後「両用型ＬＣＤ」と略称する）を、特開平１１－１０９４１７号公報において提案している。両用型ＬＣＤは、液晶表示素子の１画素分の領域内に、背面光源からの光が透過可能である透過領域と、外光を反射可能である反射領域とが作込まれている。装置周囲が暗い場合、両用型ＬＣＤは、背面光源から発せられて透過領域を通過した光を利用して表示を行う透過型液晶表示装置として用いられる。装置周囲が明るい場合、両用型ＬＣＤは、光反射率の高い反射領域において外光を反射して表示を行う反射型液晶表示装置として用いられる。

【０００５】両用型ＬＣＤに備えられる透過反射両用型（以後「両用型」と略称する）の液晶表示素子において、液晶層は、絶縁性の基板を含む主基板部と透光性を有する基板を含む対向基板部との間に介在される。図７は、両用型ＬＣＤ内の液晶表示素子の主基板部の２画素分の領域の部分拡大平面図である。図８は、図７の主基板部のＡ－Ａ端面図である。図７の液晶表示素子は、スイッチング素子として３端子素子を用いたアクティブマトリクス型の構成になっている。

【０００６】主基板部１において、絶縁性の第１基板２の液晶層側表面の１画素分の領域３には、透過領域４と反射領域５とが設定されている。透過領域３には、ＩＴＯ（インジウム－錫酸化物）から形成されて光を透過可能である画素電極透過部６が配置されている。反射領域４には、アルミニウムから形成されて光を反射可能である画素電極反射部７が配置されている。画素電極透過部６と画素電極反射部７とが、１画素分の画素電極８を構成している。画素電極反射部７と第１基板２との間には、絶縁材料の樹脂から成る調整層９が介在されている。第１基板表面の画素領域３の周囲には、画素電極８の制御に関わる配線１０が配設されている。調整層９は、反射領域５だけでなく、画素領域３の周囲の領域にも延在されており、配線１０を覆っている。主基板部１の液晶層に最近接する位置に、配向膜１１が設けられる。なお図７では、配向膜１１の一部分が省略されている。

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【０００７】両用型ＬＣＤが少なくとも液晶表示素子の前面側に偏光板を配置した構成になっているならば、両用型ＬＣＤが透過型液晶表示装置として動作する場合における表示に用いる光の実効の光路長と、両用型ＬＣＤが反射型液晶表示装置として動作する場合における表示に用いる光の実効の光路長との整合性を図る必要がある。調整層９は光路長調整のための部材である。調整層９の層厚を調整することによって、透過領域４の液晶層の層厚と反射領域５の液晶層の層厚との差が調整されて、前述の２通りの光路長が整合される。調整層９の層厚は、液晶層の透過領域に面する部分の層厚の半分程度になっており、液晶層の透過領域に面する部分の層厚が５．０μｍである場合、調整層９の層厚は２．５μｍになっている。

【０００８】両用型の液晶表示素子は、場合によっては、画素毎に、付加容量部を備えている。図９は、付加容量部を備えた両用型の液晶表示素子の主基板部１３の２画素分の領域の部分拡大平面図である。図１０は、図７の主基板部１３のＢ－Ｂ端面図である。図９の液晶表示素子の主基板部１３以外の構成は、図７の液晶表示素子の構成と等しい。図９の主基板部１３の部品のうち、図７の主基板部１の部品と同じ機能を有する部品には、同じ参照符を付して説明は省略する。なお図９の平面図では、配向膜１１の一部分の記載が省略されている。

【０００９】図９の液晶表示素子は、スイッチング素子として３端子素子を用いたアクティブマトリクス型の構成になっている。図９の主基板部１３において、付加容量用の共通配線１４は、画素電極反射部７の直下の位置を通り、かつ制御用配線１０と平行になるように、第１基板２の液晶層側表面に配置されている。共通配線１４と画素電極反射部７とが調整層９を介して重畳する部分が、画素の付加容量部１５として機能する。画素電極透過部６は反射領域４に延在されており、調整層９を介して画素電極反射部７と重なっている。画素電極反射部７は、調整層９に設けられたコンタクトホール１６を介して、画素電極透過部６と、電気的に接続されている。

【００１０】

【発明が解決しようとする課題】図７～図１０で説明した両用型ＬＣＤの液晶表示素子の主基板部１，１３では、液晶層厚の調整層９に起因して、透過領域４と反射

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領域５との境界近傍の配向膜１１表面に段差が生じる。調整層９に起因する配向膜１１の段差は、基板表面全体にわたり、各所に生じている。

【００１１】主基板部１，１３の配向膜１１は、画素電極８形成後の第１基板２上に配向膜の材料を塗布し、塗布された材料からなる薄膜に配向処理を施すことによって、形成される。配向処理のために、具体的には、ラビングローラが、塗布材料からなる薄膜表面を、所定の圧力を加えつつ、所定のラビング方向１８にラビングする。主基板部１，１３に調整層９が設けられている場合、薄膜表面に凹凸があるので、薄膜表面の凹部は凸部に比べて配向処理の効果が弱くなり、配向膜表面全体が均一に配向処理されない。

【００１２】図７の主基板部において、配向膜１１表面内の調整層９に起因した段差がある部分である壁面は、テーパ形状になっている。配向膜１１の壁面のうち、ラビング方向１８に対向する壁面２１近傍の液晶分子２２のプレティルト角は、テーパ形状の影響を受けた分だけ、配向膜１１表面の段差のない平坦な部分２３近傍の液晶分子２４のプレティルト角と異なるが、両者の液晶分子２２，２４のティルトする方向は相互に等しい。ラビング方向１８に対向する壁面２１は、表示に影響を殆ど与えない。配向膜１１表面のラビング方向の反対方向に対向する壁面２５の近傍の液晶分子２６は該壁面２５に沿って立上がろうとするため、該壁面２５近傍の液晶分子２６がティルトする方向は、配向膜１１表面の段差のない平坦な部分２３近傍の液晶分子２４がティルトする方向とは異なっている。ラビング方向１８と反対方向に対向する壁面２５近傍の液晶分子２６は、所定のティルト方向とは逆方向に傾く状態、いわゆるリバースティルトの状態になっている。この結果、ラビング方向１８と反対方向に対向する壁面２５がある領域と液晶分子が正常に配向している領域との間にディスクリネーションライン２７が生じ、ラビング方向１８と反対方向に対向する壁面２５がある領域にリバースティルトドメイン２８が生じる。これによって図７の主基板部１を有する両用型ＬＣＤの表示品位が低下する。

【００１３】図９の主基板部１３では、１画素分の領域内の配向膜表面において、共通配線１４に重なる部分と配線１０に重なる部分とが、凸状になっている。これら凸状部分のラビング方向と反対方向に対向する壁面２９，３０近傍の液晶分子は、リバースティルトの状態になっている。この結果、ラビング方向１８の反対方向に対向する壁面２９，３０がある領域と液晶分子が正常に配向している領域との間にディスクリネーションライン２７が生じ、ラビング方向１８と反対方向に対向する壁面２９，３０がある領域にリバースティルトドメイン２８が生じるため、図９の主基板部１３を有する両用型ＬＣＤの表示品位が低下する。

【００１４】本発明の目的は、ラビング処理を用いて形

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成された配向膜を有する液晶表示素子において、ラビング方向１８の反対方向に対向する配向膜壁面をできるだけ減らすことによって、配向不良に起因する表示不良の発生が防止されている液晶表示素子を提供することである。

【００１５】

【課題を解決するための手段】本発明は、間隔を空けて相互に対向する第１基板および第２基板と、第１基板と第２基板との間に配置される液晶層と、第１基板と液晶層との間に配置される第１配向膜と、第１基板と第１配向膜との間に配置される複数の画素電極と、第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、層間膜の開口部の一部分は、画素電極に重なり、前記第１配向膜の段差が生じている部分の表面である壁面は、ラビング方向の反対方向以外の方向に対して対向していることを特徴とする液晶表示素子である。

【００１６】本発明に従えば、液晶表示素子において、第１基板側の第１配向膜に、ラビング方向と反対方向に対向する壁面が存在しない。これによって液晶表示装置において、ラビング方向と反対方向に対向する壁面に起因するリバースティルトドメインおよびディスクリネーションが発生しない。したがって液晶表示素子におけるディスクリネーションに起因する表示品位の低下が防止される。

【００１７】また本発明の液晶表示素子は、前記第１配向膜の壁面は、前記ラビング方向の反対方向およびラビング方向以外の方向に対して対向していることを特徴とする。

【００１８】本発明に従えば、液晶表示素子において、第１基板側の第１配向膜に、層間膜に起因しかつラビング方向およびラビング方向の反対方向に対向する壁面の両方が存在しない。第１配向膜をこのように形成するには、層間膜が、ラビング方向と長手方向が略平行であるような帯状の形状に形成されていればよい。これによって前記反対方向に対向する壁面の原因になる層間膜の端を、容易かつ完全に無くすことができる。

【００１９】本発明は、間隔を空けて相互に対向する第１基板および第２基板と、第１基板と第２基板との間に配置される液晶層と、第１基板と液晶層との間に配置される第１配向膜と、第１基板と第１配向膜との間に配置される複数の画素電極と、第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程

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と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、層間膜の開口部の一部分は、画素電極に重なり、ラビング方向に略平行に並んで隣合う２つの画素電極が配置された領域内にある第１配向膜表面の第１基板表面からの高さが等しい部分は、連続していることを特徴とする液晶表示素子である。

【００２０】本発明に従えば、液晶表示素子において、ラビング方向に平行に並んで隣合う２つの各画素電極が配置された領域内の段差が等しい部分、すなわち前記第１配向膜内の基板表面から高さが等しい部分が連続するように、層間膜の開口部は設けられている。これによって隣合う２つの画素電極の間にありラビング方向と反対方向と対向する第１配向膜壁面の大きさが、該壁面に起因するディスクリネーションが表示品位に影響を与えない程度に、充分に小さくなる。このように液晶表示装置は、ラビング方向の反対方向に対向する壁面をできるだけ減らすように構成されているので、液晶表示素子は、ディスクリネーションに起因する表示品位の低下を、確実に防止することができる。

【００２１】本発明は、間隔を空けて相互に対向する第１基板および第２基板と、第１基板と第２基板との間に配置される液晶層と、第１基板と液晶層との間に配置される第１配向膜と、第１基板と第１配向膜との間に配置される複数の画素電極と、第２基板と液晶層との間に配置されて各画素電極と対向する対向電極と、第１基板と第１配向膜との間に配置され、かつ開口部を有する層間膜とを含み、第１配向膜は、第１基板の表面に配置された画素電極および層間膜に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向に薄膜をラビングする工程とによって製造され、前記層間膜の開口部は、ラビング方向に略平行に並んで隣合う２つの画素電極にまたがって重なっていることを特徴とする液晶表示素子である。

【００２２】本発明に従えば、液晶表示素子において、層間膜の開口部は、ラビング方向に略平行に並んで隣合う２つの画素電極にまたがるように形成されている。これによって、ラビング方向に略平行に並んで隣合う２つの画素電極の間に、層間膜が存在しない領域が形成される。前記隣合う２つの画素電極のうちの一方画素電極の層間膜と重ならない領域は、画素電極間の層間膜のない領域を介して、前記隣合う２つの画素電極のうちの他方画素電極の層間膜と重ならない領域と連続する。このように画素電極の層間膜と重ならない領域が画素毎に独立しないで連続している場合、連続している領域内に、層間膜の端に起因する第１配向膜壁面は存在しない。これによって本発明の液晶表示装置における層間膜の端に起因しラビング方向の反対方向に対向する第１配向膜壁面の数または大きさが、従来技術の液晶表示素子における層間膜の端に起因しラビング方向の反対方向に対向する

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第１配向膜壁面の数または大きさよりも減少する。このように液晶表示装置は、ラビング方向の反対方向に対向する壁面をできるだけ減らすように構成されているので、液晶表示素子におけるディスクリネーションに起因する表示品位の低下が確実に防止される。

【００２３】また本発明の液晶表示素子は、前記層間膜の開口部は、前記ラビング方向に略平行に並んで隣合う２つの画素電極のうちのラビング方向側にある一方画素電極のラビング方向側の端から、該２つの画素電極のうちの該反対方向側にある他方画素電極の該反対方向側の端に至っていることを特徴とする。

【００２４】本発明に従えば、液晶表示素子において、層間膜の開口部は、前記ラビング方向に略平行に並んで隣合う２つの画素電極のうちのラビング方向側にある一方画素電極のラビング方向側の端から、該２つの画素電極のうちの該反対方向側にある他方画素電極の該反対方向側の端に至っている。これによって、前記一方画素電極のラビング方向側の端から他方画素電極の該反対方向側の端までの領域内に、層間膜の端に起因して前記反対方向に対向する第１配向膜壁面は存在しない。このような層間膜を有する液晶表示装置では、ラビング方向と反対方向に対向する壁面に起因するリバースティルトドメインおよびディスクリネーションが発生しない。したがって液晶表示素子は、ディスクリネーションに起因する表示品位の低下を防止することができる。

【００２５】また本発明の液晶表示素子は、前記層間膜の開口部のラビング方向に直交する方向側の端は、ラビング方向と略平行であることを特徴とする。

【００２６】本発明に従えば、液晶表示素子において、層間膜の開口部のラビング方向に直交する方向側の端は、ラビング方向に略平行になっている。これによって、ラビング方向に平行に並んで隣合う２つの画素電極の間に、ラビング方向の反対方向と対向する配向膜壁面が存在しない。したがって液晶表示素子は、ディスクリネーションに起因する表示品位の低下を、さらに確実に防止することができる。

【００２７】また本発明の液晶表示素子は、前記第１配向膜の段差が生じている部分の表面である壁面のうち、前記ラビング方向に対して対向している壁面の段差は、前記液晶層の前記画素電極に対向する部分の最大層厚の１割未満であることを特徴とする。

【００２８】本発明に従えば、液晶表示素子において、第１基板側の配向膜のラビング方向の反対方向に対して対向している壁面の段差は、０より大きく、かつ液晶層の画素電極に対向する部分の最大層厚の１割未満の値になっている。前記最大層厚の１割未満の段差を有する壁面は、ラビング処理に影響を与えない。ゆえに、層間膜の画素電極上の端面に重なる第１配向膜壁面がラビング方向の反対方向以外の方向、またはラビング方向および前記反対方向以外の方向に対向しつつ、第１配向膜に残

されているラビング方向の反対方向に対向する第１配向膜壁面の段差が前記最大層厚の１割未満に抑えられているならば、リバースティルトドメインおよびディスクリネーションの発生を防止することができる。これによって液晶表示素子は、ディスクリネーションに起因する表示品位の低下を確実に防止することができる。

【００２９】また本発明の液晶表示素子は、前記画素電極は、光を透過する透過部と、前記液晶層側から到来する光を反射する反射部とから構成され、前記層間膜は、前記画素電極の反射部と前記第１基板との間に配置され、前記層間膜の開口部は、前記画素電極の透過部と重なり、前記第１基板と前記画素電極透過部と前記液晶層と前記対向電極と前記第２基板とを順次通過する第１光路を通過した光、および前記第２基板と前記対向電極と前記液晶層とを通過し前記画素電極反射部で反射されて前記液晶層と前記対向電極と前記第２基板とを再通過する第２光路を通過した光のうちの少なくとも一方が、表示に用いられ、第１光路の通過前後の光の位相差と第２光路の通過前後の光の位相差とが一致するように、前記層間膜の膜厚が設定されていることを特徴とする。

【００３０】本発明に従えば、液晶表示素子は透過反射両用型の構成になっている。液晶表示素子の層間膜は、第１光路の通過前後の光の位相差と第２光路の通過前後の光の位相差の整合に用いられている。このような液晶表示素子において、第１基板側の第１配向膜表面のラビング方向の反対方向に対向する壁面は存在しないかまたはできるだけ減少されているので、該壁面に起因するリバースティルトドメインおよびディスクリネーションの発生が充分に抑えられる。したがって両用型の液晶表示素子は、ディスクリネーションに起因する表示品位の低下を防止することができる。

【００３１】

【発明の実施の形態】図１は、本発明の第１の実施の形態である両用型の液晶表示素子３３が有する主基板部３３Ａの部分拡大平面図である。図２は、図１の液晶表示素子３３を備えた透過反射両用型液晶表示装置（以後「両用型ＬＣＤ」と略称する）３１の部分拡大断面図である。図１と図２とを合わせて説明する。図２の両用型ＬＣＤ３１の断面は、図１の主基板部３３ＡのＣ－Ｃ断面を含む。なお図１の平面図において、後述する第１配向膜４５の一部分の記載が省略されている。

【００３２】両用型ＬＣＤ３１は、両用型の液晶表示素子３３の他に、第１偏光板３５、第２偏光板３６、第１光学補償板３７、第２光学補償板３８、および光源３９を含む。各光学補償板３７，３８は、１／４波長板で実現されている。液晶表示素子３３は、概略的には、第１基板４１、第２基板４２、液晶層４３、第１配向膜４５、第２配向膜４６、複数の画素電極４７、画素電極４７と同数の対向電極４８、および液晶層厚の調整層４９を含む。

【００３３】第１基板４１と第２基板４２とは、透光性を有し、間隔を空けて対向配置される。２枚の基板４１，４２のうちの少なくとも第１基板４１は、絶縁性を有する。液晶層４３は、２枚の基板４１，４２の間に配置される。第１配向膜４５は第１基板４１と液晶層４３との間に配置される。第２配向膜４６は、第２基板４２と液晶層４３との間に配置される。２枚の配向膜４５，４６は、液晶層４３に最近接する。全画素電極４７は、第１基板４１と第１配向膜４５との間に配置される。各対向電極４８は、第２基板４２と第２配向膜４６との間に配置され、かつ各画素電極４７と対向する。調整層４９は、第１基板４１と第１配向膜４７との間に介在される層間膜であり、少なくとも１つの開口部５０を有している。調整層４９の単一の開口部５０は、後述するラビング方向５３に略平行に並んで隣合う２つの画素電極と重なるように、配置されている。

【００３４】画素電極４７と対向電極４８とによって挟まれた部分が、画素を構成している。第１基板４１の液晶層２３側の一方表面５１内の各画素電極４７が配置された領域を、画素領域５２と称する。液晶表示素子３３内の第１基板４１および第１基板４１と液晶層４３との間の部材から成る部分を、「主基板部３３Ａ」と総称する。第１配向膜４５は、主基板部３３Ａ内のどの部材よりも液晶層６３に最近接する。液晶表示素子３３内の第２基板４２および第２基板４２と液晶層４３との間の部材から成る部分を、「対向基板部３３Ｂ」と総称する。

【００３５】第１配向膜４５は、第１基板４１の一方表面５１に既に配置された画素電極４７および調整層４９に重ねて薄膜を成膜する工程と、予め定める１方向であるラビング方向５３に薄膜をラビングする工程とによって製造される。第２配向膜４５は、第１配向膜４５と同様に、薄膜の成膜工程とラビング工程とによって製造されても良く、その他の製造手法、たとえば蒸着法を用いて製造されてもよい。

【００３６】第１配向膜４５の段差のある部分の表面（以後「壁面」と称する）は、ラビング方向５３と反対の方向（以後「逆ラビング方向」と称する）５５以外の方向に対して対向していることが好ましい。逆ラビング方向５５に対向する壁面が第１配向膜４５に残っている場合、残っている壁面の段差は、０よりも大きく、かつ液晶層４３の画素電極４７に対向する部分の最大層厚ｄｔの１割未満の値であることが好ましい。本実施の形態では、第１配向膜４５の壁面のうち、画素領域５２内にある調整層４９の端面を覆う配向膜壁面５４は逆ラビング方向５５およびラビング方向５３以外の残余方向に対して対向しており、第１配向膜４５と第１基板４１との間にある全部材のうちの調整層４９以外の残余部材の端面を覆う配向膜壁面の段差は、前記最大層厚ｄｔの１割未満になっている。

【００３７】本実施の形態では、液晶表示素子３３が両

用型であるので、画素電極４７は、光を反射可能な導電性材料からなる反射部４７と、光を透過可能な導電性材料からなる透過部４８とから構成される。画素電極反射部５７は、画素領域５２内の光を反射させるべき反射領域７１に配置される。画素電極透過部５８は、画素領域５２内の光を透過させるべき透過領域７２に配置される。

【００３８】両用型液晶表示素子３３において、調整層４９は、液晶層４３の画素電極反射部５７に対向する部分の層厚、すなわち液晶層反射部の層厚ｄｒを調整するために用いられる。調整層４９は、反射部４７と第１基板４１との間に介在される。調整層４９の開口部５０は、第１基板４１表面の法線方向から見て、透過部５８と重なっている。両用型の液晶表示素子３３において、液晶層４３の画素電極４７に対向する部分の最大層厚ｄｔは、液晶層４３の画素電極透過部５８に対向する部分の層厚、すなわち液晶層透過部の層厚である。

【００３９】２枚の偏光板３５，３６は、液晶表示素子３３を挟んで対向している。第１光学補償板３７は、第１偏光板３５と第１基板４１との間に介在される。第２光学補償板３８は、第２偏光板３６と第２基板４２との間に介在される。第１偏光板３５は、第１光学補償板３７と光源３９との間に介在される。両用型ＬＣＤ３１の第２偏光板３６側が両用型ＬＣＤ３１の前面側であり、両用型ＬＣＤの光源３９側が両用型ＬＣＤ３１の背面側である。使用者は、両用型ＬＣＤ３１の前面側から両用型ＬＣＤ３１に臨む。

【００４０】本実施の形態では、さらに詳しくは、液晶表示素子３３はカラー表示が可能なアクティブマトリクス型の液晶表示素子であるので、液晶表示素子３３は、複数本の走査線６１、複数本の信号線６２、層間絶縁膜６３、画素電極４７と同数のスイッチング素子６５、複数のカラーフィルタ層６９、および遮光層７０をさらに含む。本実施の形態では、スイッチング素子６５は、３端子素子である薄膜トランジスタ（ＴＦＴ）で実現されている。１画素につき、画素電極反射部５７は２つある。液晶表示素子３３の具体的構成は、以下のとおりである。

【００４１】第１基板４１は、透光性および絶縁性を有する基板の一方面に、絶縁性を有するベースコート膜が成膜されている構成になっている。全走査線６１は、相互に平行にかつ相互に間隔を空けて、第１基板４１の一方表面５１に配置される。全信号線６２は、相互に平行にかつ相互に間隔を空けて、第１基板４１の一方表面５１に配置される。走査線６１の長手方向と信号線６２の長手方向とは、第１基板４１の一方表面５１の法線方向から見て、直交している。本実施の形態では、信号線６２の長手方向が、ラビング方向５３と平行になっている。層間絶縁膜６３は、走査線６１と信号線６２との間に介在され、かつ第１基板４１の一方表面５１全体を覆っている。画素電極４７および調整層４９は、層間絶縁膜６３と第１配向膜４５との間に介在される。

【００４２】走査線６１と信号線６２とによって囲まれた矩形領域が、画素領域５２に相当する。複数の画素領域５２は行列状に並んでいる。画素領域の配列の列または行の方向は、ラビング方向５２と略平行になっている。単一の画素領域５２において、反射領域７１は透過領域７２によって２つに分断されている。調整層４９の表面には、連続する波状の凹凸が形成されている。調整層４９表面に凹凸を形成するために、調整層４９は感光性の樹脂膜によって形成されることが好ましい。

【００４３】画素電極４７は、各画素領域５２に１つずつ配置される。第１基板４１の法線方向から見て、単一画素領域５２では、単一の画素電極透過部５８が２つの画素電極反射部５７の間に配置される。画素電極反射部５７は、反射率が比較的高い導電性材料から形成されればよく、たとえばアルミニウムによって形成される。画素電極透過部５８は、透過率が比較的高い導電性材料から形成されればよく、たとえばＩＴＯ（錫ーインジウムー酸化物）から形成される。反射部４７および透過部５８は、アルミニウムおよびＩＴＯ以外の別の材料から形成されていてもよい。

【００４４】単一画素電極４７を構成する２つの画素電極反射部５７および画素電極透過部５８は、電気的に接続されている。接続のために、各画素電極反射部５７の端部は、調整層４９の端面を覆って延伸され、画素電極透過部５８と直接接触している。これによって画素電極反射部５７と画素電極透過部５８とを容易に接続することができる。画素電極反射部５７と画素電極透過部５８との接続のための構成は、上記の構成に限らず、他の構成でもよい。たとえば調整層４９の左右の画素電極反射部５７の直下の位置にコンタクトホールがそれぞれ形成され、画素電極透過部５８が該コンタクトホールの直下の位置まで延伸されていて、左右の画素電極反射部５７は該コンタクトホールを介して画素電極透過部５８に接続されていてもよい。

【００４５】各画素領域５２の隅部に、スイッチング素子であるＴＦＴ６５が１つずつ配置される。ＴＦＴ６５のゲート電極６６は走査線６１と接続され、ＴＦＴ６５のソース電極６７は信号線６２と接続される。ＴＦＴ６５のドレイン電極６８と画素電極反射部５７との間には、前述の調整層４９が介在されている。ドレイン電極６８は、調整層４９に設けられたコンタクトホールを介して、図面左側の画素電極反射部５７と接続される。画素電極４７とＴＦＴ６５との接続のための構成は、上記の構成に限らず、他の構成でもよい。たとえば図面左側の画素電極反射部５７とドレイン電極とを調整層４９のコンタクトホールを介して接続する代わりに、ＴＦＴ６５のドレイン電極６８の一部分が延伸され、ドレイン電極６８の延在部が図面左側の画素電極反射部５７の直下

の調整層４９と層間絶縁膜６３との間に配置され、該延在部を介してドレイン電極６８が画素電極透過部５８に接続されていてもよい。これによって画素電極４７とドレイン電極６８とを容易に接続することができる。

【００４６】カラーフィルタ層６９および遮光層７０は、第２基板４１と第２配向膜４６との間に介在される。カラーフィルタ層６９は画素電極４７と対向しており、遮光層７０はブラックマトリクスとして、画素領域５２の間の領域、たとえば走査線６１および信号線６２の配置された領域と対向している。本実施の形態では全画素の対向電極４８が一体化されて１枚の透明電極を構成している。

【００４７】液晶層４３は、主基板部３３Ａと対向基板部３３Ｂとを、配向膜４５，４６同士を向かい合わせてかつ間隔を空けて配置し、両基板部の間に液晶材料を封入して形成される。本実施の形態では、液晶層２３は、誘電異方性が正である液晶材料から形成される。正の誘電異方性を有する液晶材料は、本実施の形態では、メルク社製のＺＬＩ－３９２６（商品名）またはメルク社製のＺＬＩ－４７９２（商品名）で実現される。両基板部３３Ａ，３３Ｂの間隔は、液晶層２３の透過部の層厚ｄｔが約５．０μｍになるように調整されている。調整層４９の層厚は、透過部層厚ｄｔの約半分、本実施の形態では約２．５μｍに設定されている。

【００４８】２枚の配向膜４５，４６は、画素電極４７と対向電極４８との間に電圧が生じていない間、液晶層４３内の液晶分子の長軸方向が、基板４１，４２の液晶層側表面と略平行になりかつラビング方向５３と平行に配向するように、液晶分子の配向状態を規制する。第１配向膜４５がＪＳＲ社製ＡＬ４５５２（商品名）であり液晶材料がメルク社製のＺＬＩ－３９２６である場合、電圧無印加時の液晶分子のプレティルト角は、２度以上３度以下である。電圧無印加時に液晶分子がプレティルトを有しているので、画素電極４７と対向電極４８との間に電圧が印加された場合、液晶分子がプレティルトを成している方向に、液晶分子が一様に立上がり、第１基板４１表面とほぼ垂直な方向に再配向する。

【００４９】各光学補償板３７，３８が１／４波長板であり、液晶層４３が正の誘電異方性を有する正の平行配向液晶層である場合、第１偏光板３５の偏光軸に平行な方向と第１光学補償板３７の遅相軸に平行な方向とが４５度の角度を成すように、第１偏光板３５および第１光学補償板３７が配置される。かつ第２偏光板３６の偏光軸に平行な方向と第２光学補償板３８の遅相軸に平行な方向とが４５度の角度を成すように、第２偏光板３６および第２光学補償板３８が配置される。第１光学補償板３７の遅相軸と第２光学補償板３８の遅相軸とは相互に平行になっている。これによって両用型ＬＣＤ３１は、ノーマリホワイト型になる。

【００５０】図１の液晶表示素子３３の主基板部の製造工程は、以下のとおりである。最初に、第１基板４１を形成するために、透光性および絶縁性を有する基板の一方面に、絶縁性を有するベースコート膜が成膜される。ベースコート膜は、たとえばTa_2O_5またはSiO_2から形成される。次いで、ベースコート膜の上に、遮光性および導電性を有する材料から成る薄膜がスパッタリング法を用いて成膜され、該薄膜が所定形状にパターニングされる。これによって走査線６１およびＴＦＴ６５のゲート電極６６とが形成される。走査線６１およびゲート電極６６の材料は、金属材料、たとえばアルミニウム（Ａｌ）、モリブデン（Ｍｏ）、またはタンタル（Ｔａ）で実現される。

【００５１】次いで、第１基板４１上に、走査線６１およびゲート電極６６を覆うように、、層間絶縁膜６３が積層される。層間絶縁膜６３は、たとえば、Ｐ－ＣＶＤ法を用いて、走査線製造後の第１基板４１上に、ＳｉＮｘが層厚が３０００Åになるまで積層され、この結果形成されるＳｉＮｘの薄膜が層間絶縁膜６３として用いられる。層間絶縁膜６３は、絶縁性を高めるために、２層構造になっていてもよい。層間絶縁膜６３が２層構造である場合、最初に走査線６１およびゲート電極６６の表面が陽極酸化され、次いで陽極酸化処理後の第１基板４１上に、ＣＶＤ法を用いてＳｉＮｘが積層される。この結果得られる陽極酸化膜とＳｉＮｘ薄膜とが、層間絶縁膜６３を構成する。

【００５２】層間絶縁膜６３形成後、ＴＦＴ６５のチャネル層の材料から形成される第１の薄膜が、ＣＶＤ法を用いて層間絶縁膜６３上に成膜される。第１薄膜の成膜から連続して、次いでＴＦＴ６５の電極コンタクト層の材料から形成される第２の薄膜が、ＣＶＤ法を用いて第１薄膜上に成膜される。第１薄膜は、たとえばアモルファスシリコン膜で実現される。第２薄膜は、たとえば、リン等の不純物がドーピングされたアモルファスシリコン膜、またはリン等の不純物がドーピングされた微結晶シリコン膜で実現される。第１薄膜の層厚は１５００Åであり、第２薄膜の層厚は５００Åである。次いで、ＨＣｌとSF_6との混合ガスを利用するドライエッチング法を用いて、第１薄膜および第２薄膜が所定形状にパターニングされる。これによって、ＴＦＴ６５のチャネル層およびＴＦＴ６５の電極コンタクト層とが形成される。

【００５３】次いで、ＴＦＴ６５のチャネル層および電極コンタクト層を覆うように、第１基板４１上に、透光性および導電性を有する材料から成る第３薄膜が、スパッタリング法を用いて成膜される。第３薄膜の材料は、たとえばＩＴＯで実現される。続いて、第３薄膜上に、遮光性および導電性を有する材料から成るち４薄膜が、積層して成膜される。第４薄膜の材料は、たとえば金属材料、たとえばアルミニウム（Ａｌ）、モリブデン（Ｍｏ）、またはタンタル（Ｔａ）で実現される。次いで、

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第３薄膜と第４薄膜とが所定形状にパターニングされる。この結果、ＴＦＴ６５のソース電極６７、ＴＦＴ６５のドレイン電極６８、信号線６２、および画素電極透過部５８が形成される。ソース電極６７、ドレイン電極６８、および信号線６２は、第３薄膜の一部分から成る層と第４薄膜の一部分から成る層ととの２層構造になっている。画素電極透過部５８は、第３薄膜の一部分だけから形成されている。次いで、ＴＦＴ６５を覆うように、絶縁性の材料から成り層厚が３０００Åである第５薄膜が、ＣＶＤ法を用いて成膜され、所定形状にパターニングされ、さらに所定位置にコンタクトホールが形成される。これによってＴＦＴ６５の保護膜が成膜される。なお図１には、保護膜は図示されていない。

【００５４】次いで、絶縁性を有する感光性樹脂が、ＴＦＴ６５、走査線６１、信号線６２および画素電極透過部５８を覆うように、第１基板４１上に塗布される。感光性樹脂の薄膜の層厚は、約４μｍである。樹脂塗布後、感光性樹脂の薄膜に対して、露光処理、現像処理、および熱処理が加えられる。この結果、感光性樹脂の薄膜表面に、複数の滑らかな凹凸が形成される。凹凸完成後、感光性樹脂薄膜から、保護膜のコンタクトホールの上の部分と透過領域７２上の部分と透過境界領域７６上の部分とが除去される。これによって、調整層４９が完成する。本実施の形態では、調整層４９の材料として、東京応化社製のＯＦＰＲ－８００（商品名）が用いられている。調整層４９の材料は、感光性の樹脂材料であれば、ＯＦＰＲ－８００に限らず、他の材料、たとえば東京応化社製のＯＭＲ－８３，ＯＭＲ－８５，ＯＮＮＲ－２０，ＯＦＰＲ－２，ＯＦＰＲ－８３０，またはＯＦＰＲ－５００（商品名）であってもよい。あるいは、調整層４９の材料は、Ｓｈｉｐｌｅｙ社製のＴＦ－２０，１３００－２７，１４００－２７（商品名）等であってもよく、あるいは東レ社製のフォトニース（商品名）、積水ファインケミカル社性のＲＷ－１（商品名）、日本化薬社製のＲ００１，Ｒ６３３（商品名）であってもよい。

【００５５】調整層完成後、スパッタリング法を用いて、光反射性および導電性を有する材料から成る薄膜が、調整層４９を覆うように成膜され、該薄膜が所定形状にパターニングされる。この結果画素電極反射部５７が完成する。反射部５７の材料は、たとえば金属材料、たとえばアルミニウム（Ａｌ）、またはモリブデン（Ｍｏ）で実現される。反射部５７は２層構造になっていてもよく、この場合反射部５７は、層厚が１０００Åのアルミニウムの膜片と層厚が５００Åのモリブデンの膜片とが積層されて形成される。表面に凹凸がある調整層４９の上に薄膜を成膜しパターニングして反射部５７が形成される場合、反射部５７表面にも凹凸が形成される。このように、表面に凹凸がある反射部５７は、良好な反射率および散乱特性を有することができる。

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【００５６】画素電極反射部完成後、第１配向膜４５の材料から成る薄膜が、調整層４９と画素電極反射部５７と画素電極透過部５８とを覆うように、第１基板４１上に成膜される。第１配向膜４５の材料は、たとえば、ＪＳＲ社製のオプトマーＡＬ４５５２ＬＬ（商品名）で実現される。次いで、ラビング処理として、ラビングローラが、成膜された薄膜の表面を、所定の圧力を加えつつ、所定のラビング方向５３にラビングする。この結果配向膜４５が完成する、以上の工程によって、液晶表示素子３３の主基板部３３Ａが完成する。なお液晶表示素子３３の具体的な構成および製造方法において説明した液晶表示素子３３の構成部品の具体的形状、具体的材質、および製造方法等は、液晶表示素子３３の最適例の１つである。液晶表示素子３３の構成は、第１配向膜４５表面から逆ラビング方向５５に対向する壁面をできるだけ減少させるための構成であれば、詳細構成は上記の説明に限らない。

【００５７】図２を参照して、両用型ＬＣＤ３１の表示モードについて説明する。両用型ＬＣＤ３１が反射型ＬＣＤとして動作する場合である反射モードでは、画素領域５２の反射領域７１を通過する光が、表示に用いられる。両用型ＬＣＤ３１が透過型ＬＣＤとして動作する場合である透過モードでは、画素領域５２の透過領域７２を通過する光が、表示に用いられる。画素から表示に用いられる光が射出されるか否かは、画素の画素電極４７および対向電極４８間に所定電界が印加されているか否かに応じて定まる。

【００５８】任意の単一画素において、反射モード時の光の振舞いは以下のとおりである。第２偏光板３６の表面から液晶表示素子３３内に入射した光は、第２偏光板３６を通過することによって、第２偏光板３６の偏光軸と平行な方向に振動する直線偏光になる。第２偏光板３６の偏光軸と第２光学補償板３８の遅相軸とは４５度を成しているので、第２偏光板３６通過後の直線偏光は、第２光学補償板３８に入射し通過することによって、円偏光になる。円偏光は、液晶表示素子３３の対向基板部３３Ｂを通過して、第２基板４２側から液晶層４３に入射する。

【００５９】単一画素の画素電極４７および対向電極４８間に予め定める電圧が印加されている場合、該画素電極および対向電極間の液晶層４３内に所定の電界が発生する。液晶層４３が正の誘電異方性を示す液晶材料から形成されているならば、任意画素の画素電極４７および対向電極４８間の液晶層４３の液晶分子は、基板４１，４２の表面に水平な方向に配向していた状態から、基板４１，４２の表面にほぼ垂直な方向に再配向している。ゆえに任意画素内の電極４７，４８間の液晶層４３の屈折率異方性はごく僅かであり、該液晶層４３を光が通過することによって生じる位相差は、ほぼ０である。ゆえに第２光学補償板３８通過後の円偏光が所定電圧が印加

された電極４７，４８間の液晶層４３に入射した場合、円偏光を崩さないまま、第２基板４２から第１基板４１に向かう方向に進行して液晶層４３を通過し、第１基板４１上にある画素電極反射部５７で反射される。

【００６０】反射された円偏光は、液晶層４３に第１基板４１側から再入射し、円偏光を崩さないまま、第１基板４１から第２基板４２に向かう方向に進行して液晶層４３を通過し、対向基板部３３Ｂを通過して、再び第２光学補償板３８に入射する。再入射した円偏光は、第２光学補償板３８を通過することによって、第２偏光板３６の偏光軸とは直交する方向に振動する直線偏光になる。第２偏光板３６再通過後の直線偏光は、偏光軸と直交する方向に振動しているので、第２偏光板３６を通過することなく、第２偏光板３６に吸収される。このように、画素電極４７および対向電極４８間に所定電界が発生している場合、画素は黒表示になる。

【００６１】単一画素の画素電極４７および対向電極４８間に所定電圧が印加されていない場合、該画素電極４７および対向電極４８間の液晶層４３内に所定電界が発生しないので、該液晶層４３内の液晶分子は、基板４１，４２の表面に水平な方向に配向している状態を保つ。ゆえに画素電極４７および対向電極４８間の液晶層４３の屈折率異方性は充分に大きい。ゆえに第２光学補償板３８通過後の円偏光が所定電圧が印加されていない電極４７，４８間の液晶層４３に入射した場合、円偏光は、これら両電極４７，４８間の液晶層４３を通過すると、該液晶層４３の複屈折に起因して楕円偏光になる。

【００６２】液晶層４３通過後の楕円偏光は、第１基板４１上にある画素電極反射部５７で反射され、液晶層４３に第１基板４１側から再入射する。再入射した楕円偏光は、液晶層４３を通過することによってさらに偏光状態が崩され、再び第２光学補償板３８に入射する。再入射した楕円光は、第２光学補償板３８を通過しても、第２偏光板３６の偏光軸と直交する方向に振動する直線偏光にはならない。したがって第２光学補償板３８通過後の光の全偏光成分のうち、第２偏光板３６の偏光軸と平行な方向に振動する成分が、第２偏光板３６を通過する。このように、画素電極４７および対向電極４８間に所定電界が発生していない場合、画素は白表示になる。

【００６３】任意の単一画素において、透過モード時の光の振舞いは以下のとおりである。第１偏光板３５の表面から液晶表示素子３３内に入射した光は、第１偏光板３５を通過することによって、第１偏光板３５の偏光軸と平行な方向に振動する直線偏光になる。第１偏光板３５の偏光軸と第１光学補償板３７の遅相軸とは４５度を成しているので、第１偏光板３５通過後の直線偏光は、第１光学補償板３７に入射し通過することによって、円偏光になる。円偏光は、液晶表示素子３３の主基板部３３Ａの透過領域７２を通過して、第１基板４１側から液晶層４３に入射する。

【００６４】単一画素の画素電極４７および対向電極４８間に所定電界が発生している場合、液晶層４３のこれら両電極４７，４８に挟まれた部分を光が通過することによって生じる位相差は、ほぼ０である。任意画素の液晶層４３内に所定電界が生じているならば、液晶層４３入射後の円偏光は、円偏光を崩さないまま、第１基板４１から第２基板４２に向かう方向に進行して、液晶層４３を通過して、第２光学補償板３８に入射する。第１光学補償板３７の遅相軸と第２光学補償板３８との遅相軸とは揃っているので、液晶層４３通過後の円偏光は、第２光学補償板３８を通過することによって、第２偏光板３６の偏光軸とは直交する方向に振動する直線偏光になる。第２偏光板３６再通過後の直線偏光は、第２偏光板３６に吸収される。このように、画素電極４７および対向電極４８間に所定電界が発生している場合、画素は黒表示になる。

【００６５】単一画素の画素電極４７および対向電極４８間に所定電界が発生していない場合、第１光学補償板３７通過後の円偏光は、これら両電極４７，４８間の液晶層４３を通過すると、該液晶層４３の複屈折に起因して、楕円偏光になる。楕円偏光は、第２光学補償板３８に入射する。液晶層４３通過後の楕円偏光は、第２光学補償板３８を通過しても、第２偏光板３６の偏光軸と直交する方向に振動する直線偏光にはならない。したがって第２光学補償板３８通過後の光の全偏光成分のうち、第２偏光板３６の偏光軸と平行な方向に振動する成分が、第２偏光板３６を通過する。このように、画素電極４７および対向電極４８間に所定電界が発生していない場合、画素は白表示になる。

【００６６】以上説明したように、両用型ＬＣＤ３１では、反射モードおよび透過モードのどちらでも、画素毎に、画素電極４７および対向電極４８間の電圧を調整することによって、第２偏光板３８を通過する光の光量を調整することができる。したがって両用型ＬＣＤ３１において、階調表示が可能になる。また以上説明したように、両用型ＬＣＤ３１では、液晶が正の誘電異方性を有しているので、反射モードおよび透過モードのどちらでも、画素電極４７および対向電極４８間に電圧が印加されていない状態で画素が白表示になり、電圧が印加された状態で画素が黒表示になる。すなわち両用型ＬＣＤ３１は、いわゆるノーマリホワイト型の表示を行う。

【００６７】第１の実施の形態の両用型ＬＣＤ３１では、上述した透過モードにおいて第１偏光板３７通過後から第２偏光板３８に入射するまでの光路Ｌ１の通過前後の光の位相差と、上述した反射モードにおいて第２偏光板３８通過後から第２偏光板３８に再入射するまでの光路Ｌ２の通過前後の光の位相差とは、一致していることが好ましい。透過モードの光路Ｌ１の位相差と反射モードの光路Ｌ２の位相差とが一致している場合、透過モード時に白表示される画素の輝度と、反射モード時に白

表示される画素の輝度とが一致する。

【００６８】透過モードの光路Ｌ１は、第１光学補償板３７と液晶表示素子３３の第１光路Ｌ３と第２光学補償板３８をこの順で通過する光路である。第１光路Ｌ３は、主基板部３３Ａの透過領域７２内の部分と、液晶層４３と、対向基板部３３Ｂのカラーフィルタ層６９とをこの順で通過する光路である。反射モードの光路Ｌ２は、すなわち、第２光学補償板３８を通過して液晶表示素子３３に第２基板４２側から入射し、液晶表示素子の第２光路Ｌ４を通過して第２基板４２側から射出し、第２光学補償板３８を再通過する光路である。第２光路Ｌ４は、対向基板部３３Ｂと液晶層４３とをこの順で通過して画素電極反射部５７で反射され、液晶層４３と対向基板部３３Ｂとをこの順で再通過する光路である。

【００６９】反射モードの光路Ｌ２の位相差および透過モードの光路Ｌ１の位相差は、どちらも１波長条件、すなわち２πになっていることが最も好ましい。透過モードの光路Ｌ１の位相差が１波長条件である場合、光路Ｌ１を通過して第２偏光板３６に再入射する光が第２偏光板３６の透過軸（＝偏光軸）と平行に振動する直線偏光になるので、第２偏光板３６を透過する光の光量が最大になり、白表示される画素の輝度が最大になる。同様に、反射モードの光路Ｌ２の位相差が１波長条件である場合、光路Ｌ２を通過して第２偏光板３６に再入射する光が第２偏光板３６の透過軸（＝偏光軸）と平行に振動する直線偏光になるので、第２偏光板３６を透過する光の光量が最大になり、白表示される画素の輝度が最大になる。

【００７０】一方および第２光学補償板３７，３８がどちらも１／４波長板である場合、透過モードの光路Ｌ１の位相差を１波長条件にするには、第１光路Ｌ３の通過前後の光の位相差が１／２波長条件、すなわちπになるように、画素電極透過部５８と対向電極４８との間の液晶層４３である透過領域の液晶層４３の層厚ｄｔを調整すればよい。第２光学補償板３８が１／４波長板である場合、反射モードの光路Ｌ２の位相差を１波長条件にするには、対向基板部３３Ｂと液晶層とを通過して画素電極反射部５７に至る光路Ｌ５の通過後の光の位相差が１／４波長条件、すなわち２分のπ（π／２）になるように、画素電極反射部５７と対向電極４８との間の液晶層４３である反射領域の液晶層４３の層厚ｄｒを調整する。これによって、対向基板部３３Ｂから画素電極反射部５７までの光路Ｌ５の往復に相当する第２経路Ｌ４の通過前後の光の位相差が１／２波長条件になるので、反射モードの光路Ｌ２の位相差は１波長条件になる。

【００７１】主基板部３３Ａと対向基板部３３Ｂとの間に介在される液晶層４３の層厚を部分的に変更するために、画素電極反射部５７と第１基板４１との間に、調整層４９が介在されている。主基板部３３Ａと対向基板部３３Ｂとの間隔は透過領域の液晶層４３の層厚ｄｔに応じて調整され、かつ調整層４９の層厚は透過領域の液晶層４３の層厚ｄｔと反射領域の液晶層４３の層厚ｄｒとの差に応じて調整される。このような調整層４９の層厚は、主基板部３３Ａ内の第１基板上の他の部品、たとえば画素電極４７や走査線６１よりも充分に厚い。ゆえに第１配向膜４５の調整層４９の端と重なる部分に生じている段差は、第１配向膜４５の主基板部３３Ａの他の部品の端と重なる部分に生じている段差よりも大きく、リバースチルトドメインの原因になりやすい。そこで第１の実施の形態では、調整層４９の端に起因する第１配向膜４５の壁面のうち、逆ラビング方向に対向する壁面を少なくとも除くことによって、リバースチルトドメインの発生を防止している。

【００７２】図３は図１の両用型ＬＣＤ３１の液晶表示素子３３の主基板部３３Ａの２画素分の領域およびその周囲の拡大平面図である。図３は図１の拡大平面図を簡略化して示すものである。図４は、図３の主基板部３３ＡのＤ－Ｄ断面図である。Ｄ－Ｄ断面は、第１配向膜４５のラビング方向５３と平行であり、かつ画素電極透過部５８を通っている。図３の２画素分の領域には２つの画素電極４７が配置されており、該２つの画素電極は、ラビング方向５３に略平行に並んで隣合っている。図３および図４を用いて、主基板部３３Ａの第１配向膜４５から逆ラビング方向５５と対向する壁面を除くための構成を詳細に説明する。

【００７３】なお図３および図４を用いた説明において、ラビング方向５３に略平行に並んで隣合う２つの画素電極４７のうちのラビング方向５３側にある一方画素電極４７および該一方画素電極４７が配置される画素領域５２を「上側画素電極４７Ａ」「上側画素領域５２」と記し、該２つの画素電極４７のうちの逆ラビング方向５５側にある他方画素電極４７および該他方画素電極４７が配置される画素領域５２を「下側画素電極４７Ｂ」「下側画素領域５２Ｂ」と記す。なお図３および図４を用いた説明において、部材または領域のラビング方向５３側の一端を「上端」と記し、部材または領域の逆ラビング方向５５側の他端を「下端」と記す。なお本明細書で「左」「右」とは、どちらもラビング方向５３に直交する方向であり、かつ左方向は右方向の逆方向である。さらに図３の平面図では、第１配向膜４５の一部分の記載が省略されている。

【００７４】調整層４９は、基本的には、第１配向膜４５表面の逆ラビング方向５５に対向する壁面ができるだけ減少するように、パターン形成されている。このために調整層４９の開口部５０は、基本的には、ラビング方向５３に略平行に並んで隣合う２つの画素電極４７Ａ，４７Ｂにまたがっている。すなわち、調整層４９の開口部５０の上端が、上側画素電極４７Ａと第１配向膜４５との間にあり、調整層４９の開口部の下端が、下側画素電極４７Ｂと第１配向膜４５との間にある。

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【００７５】両用型の液晶表示素子３３では、画素電極反射部５７と第１基板４１との間に調整層４９が介在され、調整層４９の開口部５０は第１基板４１の法線方向から見て画素電極透過部５８と重なる位置に配置される。このために調整層４９は、第１基板４１表面の法線方向から見て、２つの画素領域５２の反射領域７１に挟まれた領域（以後「反射境界領域」と称する）７５および反射領域７１だけに存在する。調整層４９の開口部５０は、第１基板４１表面の法線方向から見て、上側画素電極５２Ａの透過領域７２と下側画素領域５２Ｂの透過領域７２に挟まれた領域（以後「透過境界領域」と称する）７６，ならびに上側画素領域５２Ａおよび下側画素領域５２Ｂの透過領域７２と一致するように、形成されている。なお図３では、反射境界領域７５および透過境界領域７６に、斜線を付している。

【００７６】第１の実施の形態では、逆ラビング方向５５に対向する壁面およびラビング方向５３に対向する壁面の両方が第１配向膜４５に生じないように、調整層４９はパターン形成されている。このために、単一画素領域５２において、透過領域７２が、該画素領域５２の上端７３から下端７４に至る帯状の領域に形成されている。これによって、調整層４９の開口部５０は、第１基板４１の法線方向から見て、上側画素電極４７Ａの上端から下側画素電極４７Ｂの下端に至るように形成される。すなわち調整層４９の開口部５０の上端が上側画素電極４７Ａの上端と重なり、該開口部５０の下端が下側画素電極４７Ｂの下端と重なる。このような構成の開口部５０が画素単位で繰返し形成されれていれば、ラビング方向に略平行に１列に並ぶ画素電極と重なる開口部が順次連続して、１本の開口部になる。

【００７７】さらに単一画素領域７２の透過領域７２は、左右の側端がラビング方向５３と略平行になっている。上側画素領域５２Ａの右側端は、下側画素領域５２Ｂの右側端の延長線上に位置し、上側画素領域５２Ａの左側端は、下側画素領域５２Ｂの左側端の延長線上に位置する。このような構成の透過領域７２が画素単位で繰返されれていれば、ラビング方向に略平行に１列に並ぶ画素領域５２の透過領域７２と該透過領域７２間の透過境界領域７６とが順次連続して、左右の側端がラビング方向５３と略平行である１本の帯状領域になる。調整層４９を配置する必要のない前記帯状領域と重なるように開口部５０は形成されればよいので、ラビング方向５３と長手方向が略平行なストライプ状の膜片に調整層４９をパターン形成することが可能になる。これによって、調整層４９の端は逆ラビング方向５５と略平行になり、逆ラビング方向５５に対向する端は調整層４９に存在しなくなる。

【００７８】長手方向がラビング方向５３と略平行な帯状に形成された調整層４９の上に第１配向膜４５が形成される場合、第１配向膜４５表面に、調整層４９の端に

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起因し逆ラビング方向５５に対向する壁面は存在しない。以上説明したように、逆ラビング方向５３に対向する壁面だけでなく、ラビング方向５３に対向する壁面も第１配向膜４５表面から除かれるように調整層４９が形成される場合、調整層４９は帯状に形成されれば良いので、調整層４９のパターン形成が容易になる。

【００７９】図１～図４で説明した第１の実施の形態の両用型の液晶表示素子３３と、図７および図８で説明した第１の従来技術の両用型の液晶表示素子とを比較すると、以下の構成に違いがある。

【００８０】第１従来技術の両用型液晶表示素子の液晶層厚の調整層および第１配向膜以外の構成は、第１の実施の形態の両用型液晶表示素子３３と等しい。すなわち第１従来技術の液晶表示素子の第１基板の液晶層側の一方表面には、走査線と信号線とが相互に直交するように配置されており、層間絶縁膜が走査線と信号線との間に配置される。走査線および信号線によって区分された矩形領域である画素領域３内の反射領域５に画素電極反射部７が配置され、画素領域３内の透過領域４に画素電極透過部６が配置される。配向膜は、上記構成の画素電極８形成後の第１基板２上に第１配向膜４５の材料を塗布し、これによって成膜された薄膜を所定のラビング方向５３にラビングすることによって、形成される。このような構成の主基板部１は、誘電異方性が正である平行配向液晶層を介して、図２で説明した構成と等しい対向基板部に貼合わされる。第１従来技術においても、両用型ＬＣＤの透過領域のリタデーション（位相差）と両用型ＬＣＤの反射領域のリタデーションとを一致させるために、調整層９の層厚は透過領域の液晶層の層厚の半分程度になっている。

【００８１】第１従来技術において、反射領域５は「ロ」型であり、透過領域４を取囲んでいる。ゆえに、第１基板２の法線方向から見て、第１従来技術の第１配向膜表面の反射領域５と透過領域４との境界に重なる位置に、逆ラビング方向５５に対向する壁面２５が存在し、該壁面２５の段差は液晶層の画素電極に対向する部分の最大層厚の１割よりも大きいので、該壁面２５近傍にリバースチルトドメイン２６が発生する。この結果、ラビング方向１８と反対方向に対向する壁面２５がある領域と液晶分子が正常に配向している領域との間にディスクリネーションライン２７が生じるので、両用型ＬＣＤのコントラストおよび応答速度が低下する。この結果、両用型ＬＣＤの表示品位が低下する。

【００８２】図１～図４に示す第１の実施の形態の液晶表示素子３３の第１配向膜４５の表面には、調整層４９に起因し逆ラビング方向５５に対向する壁面が存在しないので、該壁面に起因するリバースチルトドメインおよびディスクリネーションラインが発生しない。これによって第１の実施の形態の液晶表示素子３３は、液晶層４３内の液晶分子を均一に配向させることができる。した

がって第１の実施の形態の両用型ＬＣＤ３１のコントラストおよび応答速度が第１従来技術よりも向上するので、第１の実施の形態の両用型ＬＣＤ３１の表示品位が、従来技術の両用型ＬＣＤの表示品位よりも向上する。

【００８３】逆ラビング方向５５に対向する配向膜壁面の段差が、液晶層２３の画素電極４７に対向する部分の最大層厚ｄｔの１割の高さよりも大きい場合、該配向膜壁面はディスクリネーションを引起こす。逆ラビング方向５５に対向する配向膜壁面は、段差が０より大きく前記最大層厚ｄｔの１割以下の高さであるならば、第１配向膜４５表面に残っていても、ＬＣＤの表示品位に影響を与えない。たとえば図１～図４の両用型ＬＣＤ３１では、走査線６１の端および画素電極透過部５８の端と第１配向膜４５とが重なる位置に、逆ラビング方向５５に対向する配向膜壁面やラビング方向５３に対向する配向膜壁面が残っている。これら残っている壁面の段差は高々０．１μｍ以上０．３μｍ以下の高さであり、液晶層２３の透過部の層厚ｄｔが５．０μｍであるので、残っている段差に起因してリバースチルトドメインが発生することはない。

【００８４】このように、逆ラビング方向５５に対向する壁面が配向膜表面内に残っている場合、該壁面の段差が０より大きく液晶層２３の画素部の最大層厚ｄｔの１割以下に抑えられているならば、ディスクリネーションおよびリバースチルトドメインの発生が防止されるので、液晶層４３内の液晶分子を良好な表示に充分な程度に均一に配向させることができる。ゆえに逆ラビング方向５５に対向する端が存在しないように調整層をパターニングする代わりに、配向膜壁面の段差が０より大きく最大層厚ｄｔの１割以下になるように、第１配向膜４５と基板４１との間の部品を構成してもよい。

【００８５】第１配向膜４５と第１基板４１との間の部材のテーパ角が、０度より大きく、第１基板４１に対する液晶分子のプレティルト角未満の角度である場合、該部材の端を覆う第１配向膜４５の壁面近傍の液晶分子の配向はリバースティルトにならない。一般的にプレティルト角は１度～９度であるので、部材のテーパ角はプレティルト角以上になっている。所定の段差を有する配向膜壁面においては、該壁面が覆う部材端のテーパ角が小さいほど、ディスクリネーションが発生しにくくなる。

【００８６】本件出願人は、第１の実施の形態の液晶表示素子３３を備えた両用型ＬＣＤと、第１従来技術の液晶表示素子を備えた両用型ＬＣＤとをそれぞれ製造して、両者の両用型ＬＣＤの表示状態を観察した。第１の実施の形態の両用型ＬＣＤの詳細構成は、上述した製造工程で説明された構成である。第１従来技術の両用型ＬＣＤの詳細構成は、調整層および画素電極の平面形状だけが第１の実施の形態の両用型ＬＣＤと異なり、他の構成は第１の実施の形態の両用型ＬＣＤと等しい。第１従来技術の両用型ＬＣＤを前面側から光学顕微鏡を用いて観察したところ、逆ラビング方向に対向する配向膜壁面が存在する箇所近傍に、ディスクリネーションラインの発生が確認された。第１の実施の形態の両用型ＬＣＤを前面側から光学顕微鏡を用いて観察したところ、ディスクリネーションラインは発生していなかった。

【００８７】本件出願人は、さらに、第１従来技術の両用型ＬＣＤのコントラストと、第１の実施の形態の両用型ＬＣＤのコントラストとをそれぞれ測定し、比較した。この結果、第１の実施の形態の両用型ＬＣＤのコントラストは、第１従来技術の両用型ＬＣＤのコントラストよりも、１０％～２０％向上していた。これは以下の理由に基づく。ディスクリネーションラインは、画素を黒表示する際に画素からの光漏れを発生させるので、両用型ＬＣＤのコントラスト低下の原因になる。第１の実施の形態の両用型ＬＣＤにはディスクリネーションラインが発生していないので、ディスクリネーションラインに起因する光漏れがなくなったため、第１の実施の形態の両用型ＬＣＤコントラストが向上している。

【００８８】このように、第１の実施の形態の液晶表示素子３３を備えた両用型ＬＣＤにおいては、第１従来技術の液晶表示素子を備えた両用型ＬＣＤよりも、表示品位が向上している。第１の実施の形態の液晶表示素子３３と第１従来技術の液晶表示素子の構成とは、調整層４９および画素電極４７の平面形状だけが異なる。したがって、従来技術の液晶表示素子の構成および製造工程に微小な変更を加えるだけで、第１の実施の形態の液晶表示素子３３の設計および製造工程の設計が可能なので、第１の実施の形態の液晶表示素子３３の実現は容易である。

【００８９】なお第１の実施の形態では、第１配向膜４５に平行配向処理が施されている。これに限らず、第１配向膜４５には、垂直配向処理が施されてもよい。垂直配向処理を伴う第１配向膜４５の形成手法は、たとえば以下のとおりである。まず最初に、垂直配向膜の材料からなり膜厚が８０ｎｍである薄膜が、画素電極４７形成後の第１基板４１上に印刷技術を用いて成膜される。垂直配向膜の材料は、たとえば日本合成ゴム（株）製のＪＡＬＳ２００４である。成膜後の薄膜は１８０度で２時間焼成される。焼成後の薄膜の表面が、レーヨン製の布を巻き付けたラビングローラによって、ラビング方向５３にラビングされる。ラビング処理時のラビングローラの回転数は１００ｒｐｍであり、ローラに対する基板の移動速度は１分あたり１００ｍｍ（１００ｍｍ／ｍｉｎ）である。これによって垂直配向処理が施された第１配向膜４５が完成する。第１配向膜４５に垂直配向処理が施される場合でも、平行配向処理が施された場合と同様に、両用型ＬＣＤ３１の表示品位は向上される。

【００９０】図５は、本発明の第２の実施の形態である液晶表示素子が有する主基板部１０１の２画素分の領域

およびその周囲の簡略化された拡大部分平面図である。図６は、図５の主基板部１０１のＥ－Ｅ断面図である。図５と図６とを合わせて説明する。なお第２の実施の形態の液晶表示素子は、第１の実施の形態の液晶表示素子３３の主基板部３３Ａを図５の主基板部１０１に置換えた構成になっている。図５の主基板部１０１の部品のうち、図１の主基板部３３Ａの部品と同じ機能を有する部品には、同じ参照符を付して説明は省略する。なお図５および図６を用いた説明において、「上側画素電極４７Ａ」「上側画素領域５２」「下側画素電極４７Ｂ」「下側画素領域５２Ｂ」「上端」「下端」「右」「左」の定義は、図３および図４の説明における定義と等しい。図５の２画素分の領域には２つの画素電極４７が配置されており、該２つの画素電極は、ラビング方向５３に略平行に並んで隣合っている。Ｅ－Ｅ断面は、第１配向膜４５のラビング方向５３と平行であり、かつ画素電極透過部５８を通っている。さらに図５の平面図では、第１配向４５の一部分の記載が省略されており、反射境界領域および透過境界領域に斜線が付してある。

【００９１】図５の主基板部１０１は、図１の主基板部３３Ａの各画素領域５２に、付加容量部１０３のための付加容量配線１０３を追加した構成になっている。付加容量配線１０３が層間絶縁膜６３を介して画素電極４７に重畳している部分が、付加容量部１０４として機能する。付加容量配線１０３は、本実施の形態では、付加容量配線１０３は、画素領域５２の中央部を通り、かつ長手方向がラビング方向５３と直交する方向と平行になるように、層間絶縁膜６３と第１基板４１との間に配置されている。第１基板４１の法線方向から見て付加容量配線１０３と重なる位置では、画素電極透過部５８の延在部と画素電極反射部５７とが調整層４９を介して重なり合っている。反射部５７と透過部５８延在部との間の調整層４９にはコンタクトホール１０５が設けられており、画素電極透過部５８の延在部と画素電極反射部５７とはコンタクトホール１０５を介して接続されている。このような主基板部１０１を備えた第２の実施の形態の両用型の液晶表示素子を有する両用型ＬＣＤは、第１の実施の形態の両用型ＬＣＤ３１の液晶表示素子３３を、第２の実施の形態の液晶表示素子に置換えた構成になっている。

【００９２】付加容量配線１０３は一般的に遮光性を有する導電性材料から形成されるので、付加容量配線１０３が配置された領域を透過領域７２として用いることは難しい。このために第２の実施の形態では、画素電極反射部５７が「Ｈ」状に形成されており、付加容量配線１０３が配置された領域は反射領域７１に含まれている。この結果単一の画素領域５２において、透過領域７２は、上端が画素領域５２の上端７３と重なっている第１領域１１１と、一端が画素領域５２の下端７４と重なっている第２領域１１２との２つに分断されている。

【００９３】調整層４９は、第１配向膜４５にある逆ラビング方向５５に対向する壁面の数をできるだけ減少させるために、ラビング方向５３に略平行に並んで隣合う２つの画素電極４７Ａ，４７Ｂが配置された領域１１３において、第１配向膜４５表面の第１基板４１表面からの高さが等しい部分が連続するように、調整層４９は形成される。このために調整層４９の開口部５０は、ラビング方向に略平行に並んで隣合う２つの画素電極４７Ａ，４７Ｂにまたがっている。

【００９４】図５の構成では、具体的には、下側画素領域５２Ｂの第１領域１１１と上側画素領域５２Ａの第２領域１１２とが、該２つの画素領域５２Ａ，５２Ｂ間にある透過境界領域７６とそれぞれ接しているので、これら３つの領域１１１，１１２，７６が連続し単一領域を形成している。調整層４９の開口部５０は、第１基板４１の法線方向から見て、これら３つの領域１１１，１１２，７６から形成される単一領域と重なっている。これによって、上側および下側画素電極５２Ａ，５２Ｂが配置された領域１１３内の第１配向膜４５表面内の第１基板４１酔う面からの高さが等しい部分は、画素領域５２を越えて相互に連続するので、ラビング方向５３に略平行に並んで隣合う２つの画素領域５２の間の領域およびその近傍には、逆ラビング方向５５に対向する壁面が存在しない。この結果第１配向膜５２の単一の画素領域５２内にある部分の表面において、逆ラビング方向５５に対向する壁面１０７およびラビング方向５３に対向する壁面１０８は、調整層４９の付加容量配線１０３と重なる部分の端にだけ起因して生じる。

【００９５】図５および図６に示す第２の実施の形態の液晶表示素子の主基板部１０１と、図９および図１０に示す第２従来技術の液晶表示素子の主基板部１３とを比較すると、以下の構成に違いがある。第２従来技術の主基板部１３では、反射領域の平面形状は「８」の字型なので、調整層９は、反射領域７だけでなく、画素領域の四方周囲全体に配置される。この結果第２従来技術の主基板部１３の配向膜１１の単一画素領域８内にある部分の表面には、逆ラビング方向５３に対向する壁面が２カ所存在する。第２の実施の形態の主基板部１０１では、反射領域７１の平面形状は「Ｈ」型であり、かつ透過領域７２だけでなく透過境界領域７６からも調整層４９が除かれている。この結果第２の実施の形態の主基板部１０１の配向膜４５の単一画素領域５２内にある部分の表面には、逆ラビング方向５３に対向する壁面が付加容量配線１０３上に１カ所だけ存在する。

【００９６】このように第２の実施の形態の主基板部１０１における逆ラビング方向５３に対向する配向膜壁面の数は、第２従来技術の主基板部１３における逆ラビング方向５３に対向する配向膜壁面の数の半分になっている。これによってこのように第２の実施の形態の主基板部１０１を有する液晶表示素子におけるディスクリネー

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ションラインが発生する可能性のある箇所は、第２従来技術の主基板部１３を有する液晶表示素子におけるディスクリネーションラインが発生する可能性のある箇所よりも半減するので、第２の実施の形態の液晶表示素子の表示品位は第２従来技術の液晶表示素子の表示品位よりも向上する。このように第２の実施の形態の液晶表示素子は、画素電極反射部の面積を従来技術から殆ど変えることなく、画素領域周縁部におけるリバースチルトを防止することができる。

【００９７】なお第２の実施の形態の主基板部１０１の第１配向膜４５には、走査線６１の端および画素電極透過部５８の端と第１配向膜４５とが重なる領域に、逆ラビング方向５５に対向する壁面やラビング方向５３に対向する壁面が残っている。これら残っている壁面の段差は高々０．１μｍ以上０．３μｍ以下の高さであり、液晶層２３の透過部の層厚ｄｔが５．０μｍであるので、第１の実施の形態で説明した理由に基づき、残っている段差に起因してリバースチルトドメインが発生することはないことが分かっているので、これら段差に起因した表示品位の低下は起こらない。

【００９８】第１および第２の実施の形態の液晶表示素子は、本発明の液晶表示素子の例示であり、主要な構成が等しければ、他の様々な構成で実現することができる。特に液晶表示素子の各構成部品の詳細な構成は、同じ効果が得られるならば、上述の構成に限らず他の構成によって実現されてもよい。

【００９９】たとえば、両用型の液晶表示素子の構成部品のうち、調整層４９が反射領域７１および反射境界領域７６だけに配置されて透過領域７２および透過境界領域７６から除かれている構成になっていれば、他の部品の構成は第１および第２の実施の形態で説明した構成に限らず、他の構成であってもよい。これによって両用型の液晶表示素子の主基板部の第１配向膜４５は逆ラビング方向５５に対向する壁面ができるだけ少なくなるように形成されるので、ディスクリネーションラインおよびリバースチルトドメインに起因する両用型ＬＣＤの表示品位の低下が抑えられる。

【０１００】また第１および第２の実施の形態の液晶表示素子がＴＮ型またはＳＴＮ型になっているので、両用型ＬＣＤが偏光板を用いた構成になっているが、液晶表示素子はこれに限らず、他の構成、たとえばＧＨ型であってもよい。両用型ＬＣＤが偏光板を用いない構成であっても、第１および第２の実施の形態の両用型ＬＣＤと同様に、液晶層透過部の実効的な層厚と液晶層反射部の実効的な層厚とを一致させることが好ましい。すなわち液晶層透過部の第１光路Ｌ３通過前後の光の位相差が、液晶層反射部の第２光路Ｌ４通過前後の光の位相差と一致するように、液晶層反射部の層厚ｄｒを調整層４９を用いて調整することが好ましい。たとえば液晶表示素子がＧＨ型である場合、液晶層透過部の実効的な層厚が液

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晶層反射部の実効的な層厚と一致しているならば、液晶層透過部における二色比と液晶層反射層部における二色比とを合わせることができる。

【０１０１】また配向膜４５表面の逆ラビング方向５５に対向する壁面ができるだけ少なくなるように形成された液晶表示素子は、配向処理としてラビング処理が施された配向膜を有する液晶表示素子であれば、両用型液晶表示素子に限らず、他の型の液晶表示素子、たとえば投射型液晶表示素子であってもよい。さらに除去対象となる配向膜壁面は、調整層４９の端を覆う壁面に限らず、配向膜と基板との間のどのような部材の端を覆っていても良い。さらに第１および第２の実施の形態では、段差を除去する対象の配向膜は主基板部３３Ａ，１０１の第１配向膜４５を段差除去対象の配向膜としているが、対向基板部３３Ｂの第２配向膜４６に、液晶層の画素領域５２に対向する部分の最大層厚ｄｔの１割以上の段差を有し逆ラビング方向に対向する壁面が対向基板部３３Ｂの第２配向膜４６に生じるならば、主基板部３３Ａ，１０１からの壁面除去手法と同様の手法で、対向基板部３３Ｂから壁面を除去してもよい。

【０１０２】第１基板４１の法線方向から見て、ラビング方向に略平行に並んで隣合う２つの画素電極４７Ａ，４７Ｂの透過領域７２が単一の調整層開口部５０と重なる場合、上側画素領域５２Ａの透過領域７２の左右の側端から、下側画素領域５２Ｂの透過領域７２の左右の側端の延長線までの、ラビング方向５３の直交方向の距離は、左右それぞれにおいて、できるだけ短いことが好ましい。これは以下の理由に基づく。上側画素領域５２Ａの透過領域７２の左右の側端が下側画素領域５２Ｂの透過領域７２の左右の側端の延長線からずれている場合、開口部５０の左右の側端に逆ラビング方向５５に対向する部分が存在し、該部分は、配向膜表面に逆ラビング方向５５に対向する壁面が生じる原因になる。上側画素領域５２Ａの透過領域７２の左右の側端から下側画素領域５２Ｂの透過領域７２の左右の側端延長線までの左右方向の距離が小さいほど、開口部５０の左右の側端の逆ラビング方向５５に対向する部分が小さくなるので、逆ラビング方向５５に対向する配向膜壁面が小さくなり、液晶分子の配向に与える影響が小さくなる。

【０１０３】第１および第２の実施の形態の液晶表示素子において、調整層４９の開口部５０の左右の側端のうちの少なくとも一方は、ラビング方向５３と略平行になっていることが最も好ましい。調整層４９の開口部５０の左右の側端をラビング方向５３と略平行にするには、上側画素領域５２Ａの透過領域７２の左右の側端から下側画素領域５２Ｂの透過領域７２の左右の側端延長線までの左右方向の距離を０にすればよい。これによって、ラビング方向に平行に並んで隣合う２つの画素電極の間に、ラビング方向の反対方向と対向する配向膜壁面が存在しない。したがって液晶表示素子は、ディスクリネー

ションに起因する表示品位の低下を、さらに確実に防止することができる。

【０１０４】

【発明の効果】以上のように本発明によれば、液晶表示素子において、第１基板と第１配向膜との間に、開口部を有する層間膜と画素電極とが配置される。層間膜の開口部は、第１配向膜にラビング方向と反対方向に対向する壁面が存在しないように、形成される。これによって液晶表示素子の表示品位の低下が防止される。また本発明によれば、液晶表示素子において、第１基板側の第１配向膜に、層間膜に起因しかつラビング方向およびラビング方向の反対方向に対向する壁面の両方が存在しない。これによって前記反対方向に対向する壁面の原因になる層間膜の端を、容易かつ完全に無くすことができる。

【０１０５】また以上のように本発明によれば、液晶表示素子において、ラビング方向に平行に並んで隣合う２つの各画素電極が配置された領域内にある前記第１配向膜の基板表面から高さが等しい部分が連続するように、層間膜の開口部は設けられている。このように液晶表示装置は、ラビング方向の反対方向に対向する壁面をできるだけ減らすように構成されているので、液晶表示素子は、表示品位の低下を確実に防止することができる。

【０１０６】さらにまた以上のように本発明によれば、液晶表示素子において、層間膜の開口部は、ラビング方向に略平行に並んで隣合う２つの画素電極にまたがるように形成されている。これによって画素電極と層間膜とが重ならない領域が画素毎に独立しないで連続しているので、液晶表示素子はラビング方向の反対方向に対向する壁面をできるだけ減らすように構成されている。ゆえに液晶表示素子の表示品位の低下が確実に防止される。

【０１０７】また本発明によれば、層間膜の開口部は、前記ラビング方向に略平行に並んで隣合う２つの画素電極のうちのラビング方向側にある一方画素電極のラビング方向側の端から、該２つの画素電極のうちの該反対方向側にある他方画素電極の該反対方向側の端に至っている。これによって液晶表示素子は、表示品位の低下をさらに防止することができる。さらにまた本発明によれば、液晶表示素子において、層間膜の開口部のラビング方向に直交する方向側の端は、ラビング方向に略平行になっている。これによって液晶表示素子は、表示品位の低下を、さらに確実に防止することができる。また本発明によれば、液晶表示素子において、第１基板側の第１配向膜のラビング方向の反対方向に対して対向している壁面の段差は、０より大きく、かつ液晶層の画素電極に対向する部分の最大層厚の１割未満の値になっている。これによって液晶表示素子は、表示品位の低下を確実に防止することができる。

【０１０８】さらにまた本発明によれば、液晶表示素子は透過反射両用型であり、層間膜は、表示に用いる光の光路の通過前後の光の位相差の整合に用いられている。層間膜に起因しラビング方向の反対方向に対向する壁面の発生ができるだけ抑えられているので、両用型の液晶表示素子は表示品位の低下を防止することができる。

【図面の簡単な説明】

【図１】本発明の第１の実施の形態である液晶表示素子３３が有する主基板部３３Ａの１画素分の領域およびその周囲の拡大部分平面図である。

【図２】図１の液晶表示素子３３を備えた両用型ＬＣＤ３１の部分拡大断面図である。

【図３】図１の液晶表示素子３３の主基板部３３Ａの２画素分の領域およびその周囲の簡略化された拡大部分平面図である。

【図４】図３の液晶表示素子３３の主基板部３３Ａの１画素分の領域のＤ－Ｄ断面図である。

【図５】本発明の第２の実施の形態である液晶表示素子が有する主基板部１０１の２画素分の領域およびその周囲の簡略化された拡大部分平面図である。

【図６】図５の液晶表示素子の主基板部１０１の１画素分の領域のＥ－Ｅ断面図である。

【図７】第１従来技術の液晶表示素子が有する主基板部１の２画素分の領域およびその周囲の簡略化された拡大部分平面図である。

【図８】図７の液晶表示素子の主基板部１の１画素分の領域のＡ－Ａ断面図である。

【図９】第２従来技術の液晶表示素子が有する主基板部１３の２画素分の領域およびその周囲の簡略化された拡大部分平面図である。

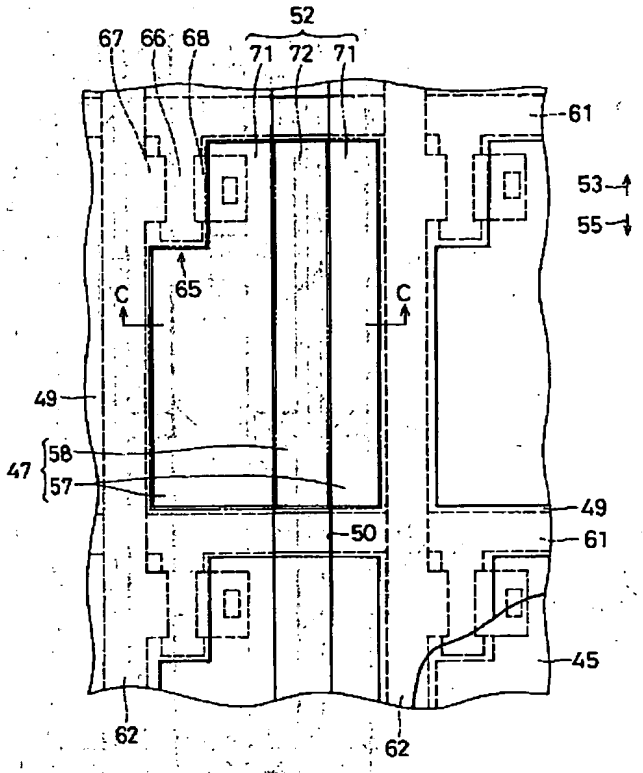
【図１０】図９の液晶表示素子の主基板部１３の１画素分の領域のＢ－Ｂ断面図である。

【符号の説明】

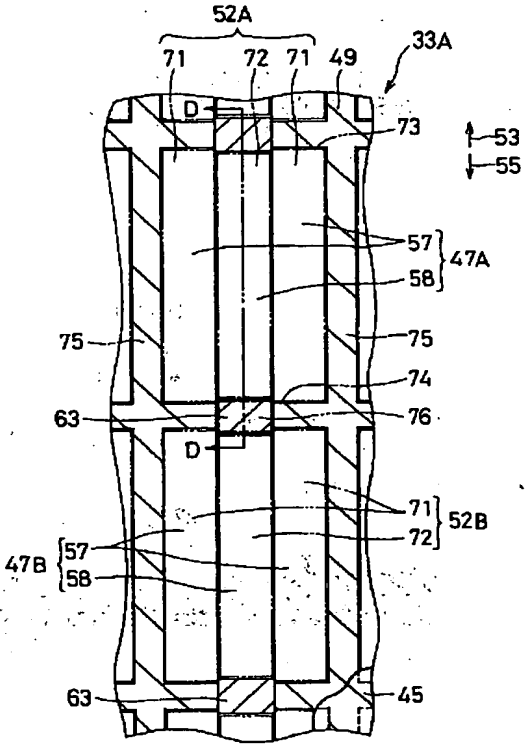
４１　第１基板
４２　第２基板
４３　液晶層
４５　第１配向膜
４６　第２配向膜
４７　画素電極
４８　対向電極
４９　調整層
５０　調整層の開口部
５２　画素領域
５３　ラビング方向
５５　ラビング方向の反対方向
５４　第１配向膜の端面
５７　画素電極の反射部
５８　画素電極の透過部
７１　画素領域の反射領域
７２　画素領域の透過領域
７５　反射境界領域
７６　透過境界領域

ｄｔ　液晶層の画素電極に対向する部分の最大層厚

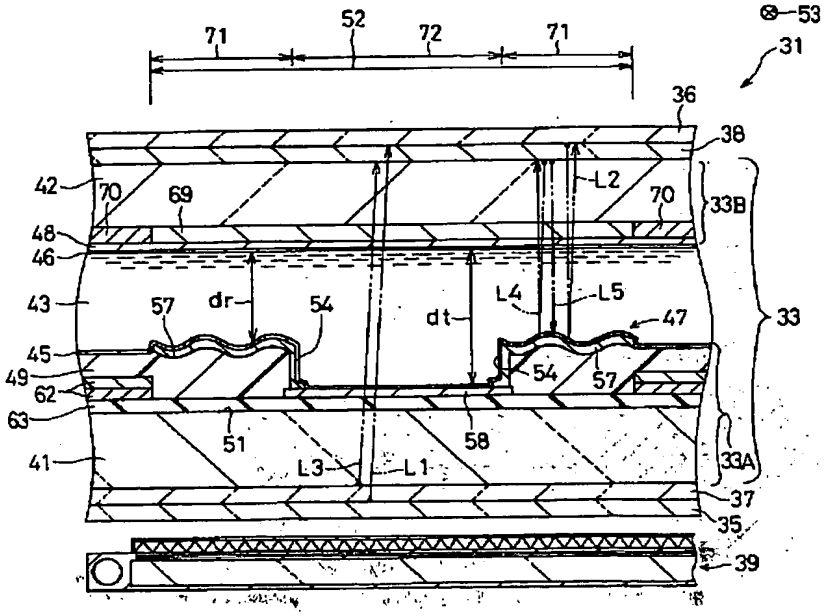
【図１】



【図３】



【図２】



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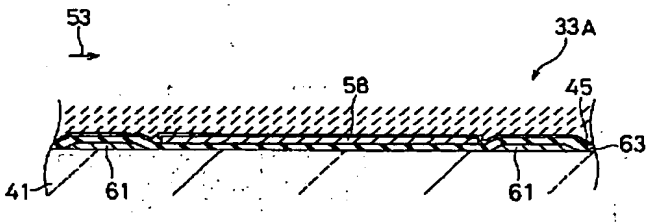
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33A
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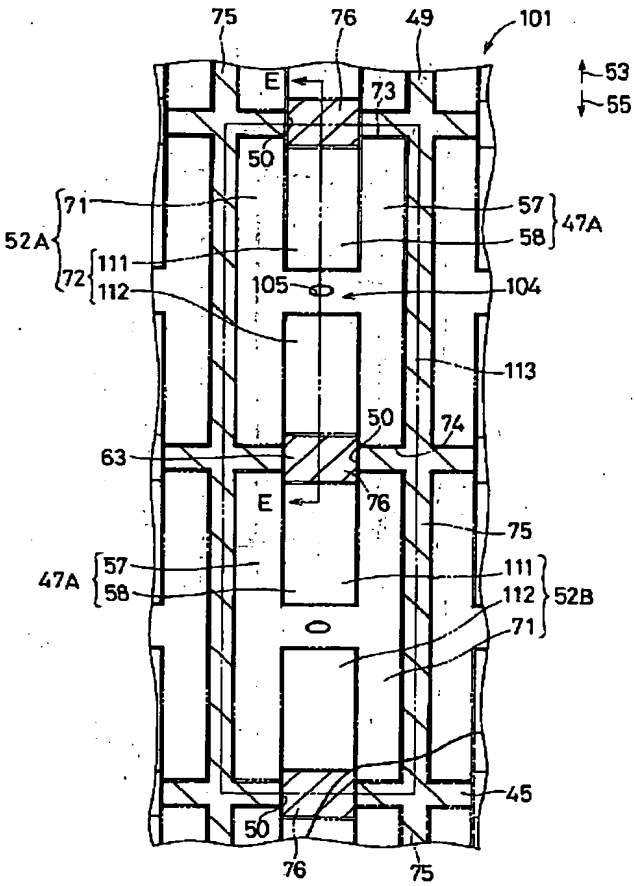
45
63
41
61
61

【図５】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E
73
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57
47A
52A
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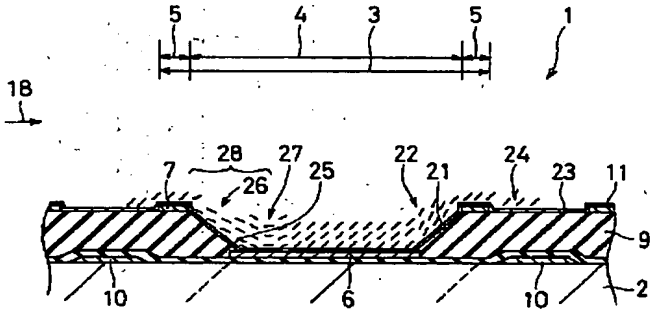
72
111
112
105
104
113
50
74
63
E
76
75
47A
57
58
111
112
52B
71
45
50
76
75

【図８】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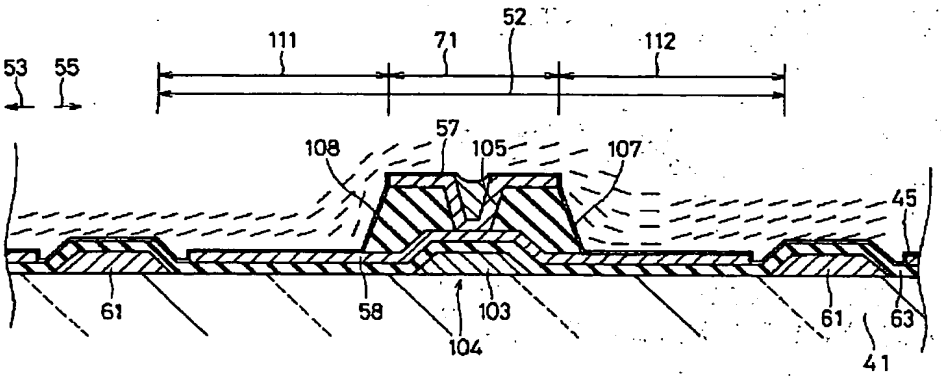
【図６】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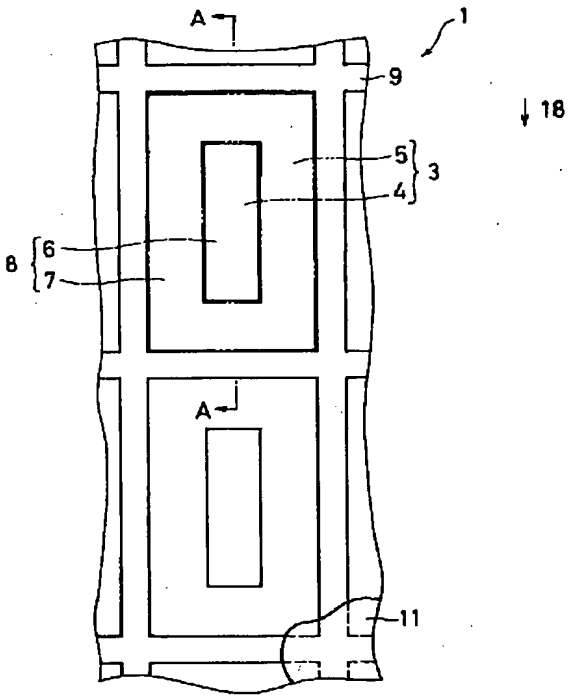
【図７】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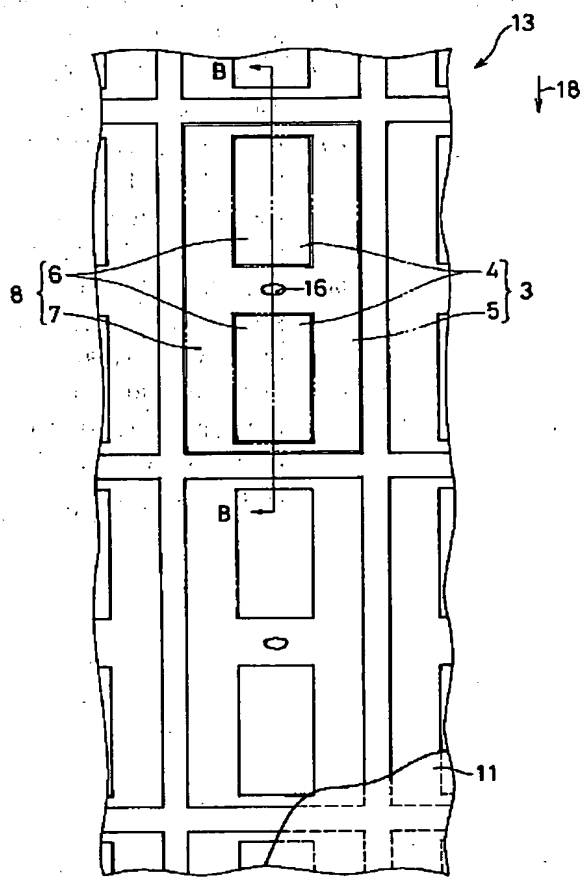
7
A
11

【図９】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16
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5
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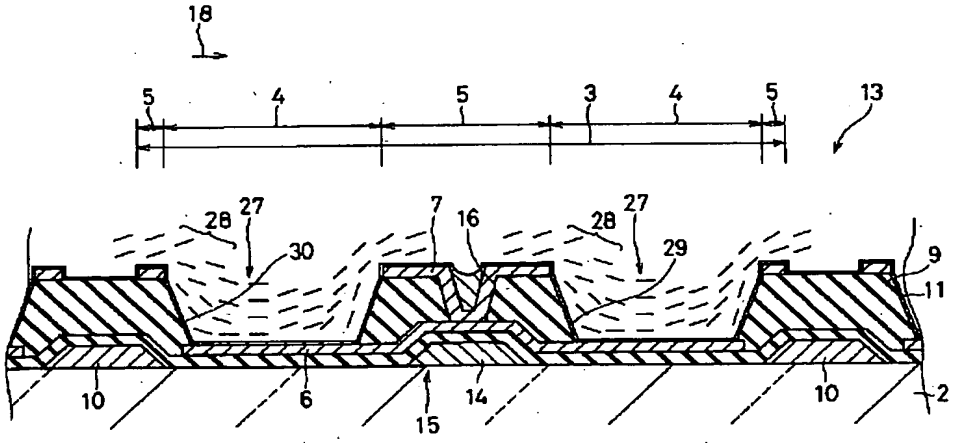
B
11

【図１０】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